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THE INSECT PESTS OF COTTON IN TROPICAL AFRICA

by E. O. PEARSON

Director, Commonwealth Institute of Entomology,
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Cotton is one of the most important crops cultivated in tropical Africa and no comprehensive account exists of the numerous pests that attack it in that continent. The present work provides a concise and critical *résumé* of the available information, formerly scattered through the literature, to which a full bibliography is given, and much hitherto unpublished information is also included.

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The main section of the book consists of an account of each of the more important pests, dealing with the taxonomy and distribution, appearance of the different stages, life-history and seasonal activity, nature of the damage inflicted on cotton, alternative host plants, natural enemies, factors affecting prevalence, and control. In the case of species or groups that are not confined to tropical Africa, relevant matter available from research on them elsewhere is included.

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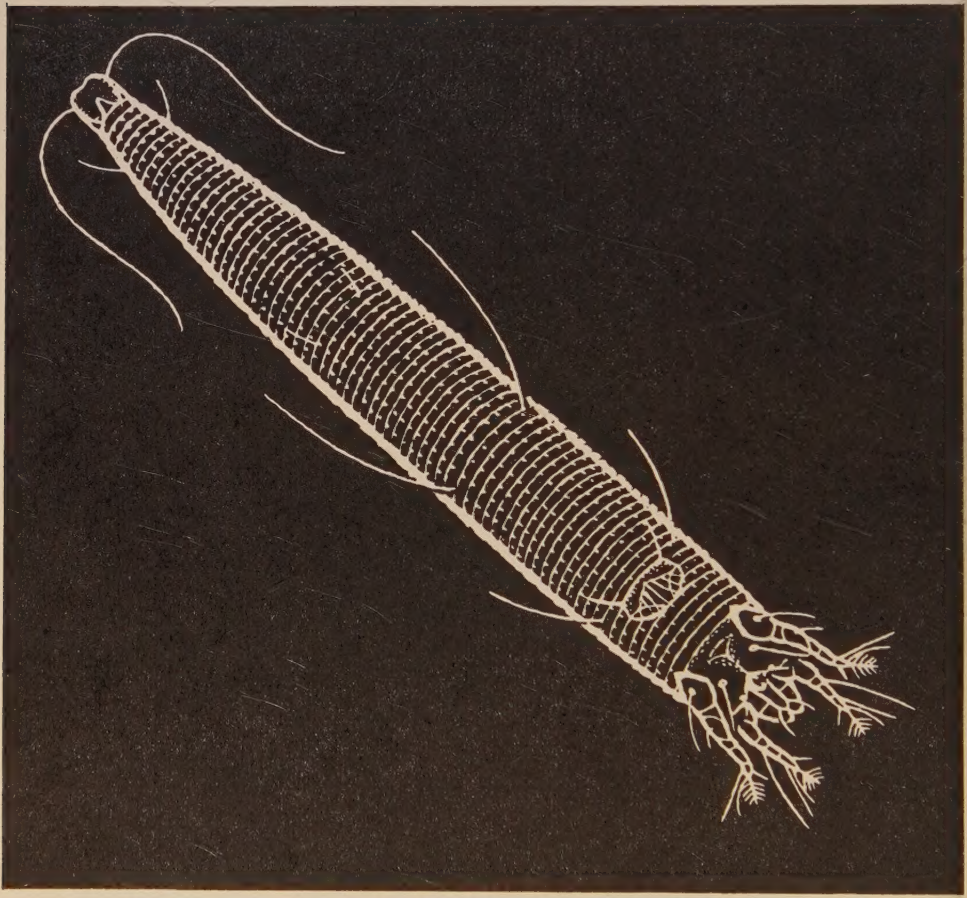

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STEVENSON (J. H.). **The effect of pyrethrins and piperonyl butoxide against the moths** *Plodia interpunctella* **and** *Ephestia cautella*.—*Chem. & Ind.* 1958 p. 827, 3 refs. London, 1958.

J. P. Brooke reported that the synergistic effect of piperonyl butoxide in admixture with pyrethrins was low in tests with *Ephestia elutella* (Hb.), and C. J. Lloyd & P. S. Hewlett found that a film of 1·3 per cent. pyrethrins was much more toxic to larvae of *E. cautella* (Wlk.) than one containing 0·3 per cent. pyrethrins and 3 per cent. piperonyl butoxide [*R.A.E.*, A **46** 171]. In tests in which adults and larvae of *E. cautella* and *Plodia interpunctella* (Hb.) were exposed to deposits of pyrethrins alone or with 5 times their volume of piperonyl butoxide on filter paper, the addition of piperonyl butoxide failed significantly to enhance the toxicity of pyrethrins, and the same result was obtained when the larvae were exposed to similar deposits on wood and the *Plodia* larvae were treated by topical application. Biological assay proved to be consistently less precise with moths than with beetles, and factors of synergism of less than two should seldom be treated as significant.

MOISEEV (A. E.) & SHTEĬNBERG (G. G.). **Separate cutting and threshing of grain and control of** *Eurygaster integriceps*. [*In Russian.*]—*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **23** no. 1 pp. 20–22. Moscow, 1958.

When winter wheat is left to ripen for combine-harvesting in the Rostov region of the Soviet Union, harvesting is sufficiently late for the nymphs of *Eurygaster integriceps* Put. to complete their development on it and for the newly emerged adults to accumulate food reserves sufficient for hibernation and to fly away normally. On some farms, cutting and threshing are performed in separate operations, and the grain is then cut earlier and left in the field to dry before threshing. Observations in 1956 showed that cutting in July, before adult emergence had occurred, did not reduce the infestation of the cut grain or hinder the development of the bugs on it, but most of these were destroyed during the process of mechanical threshing, especially if this took place soon after cutting.

ISAKOVA (N. P.). **A new variety of bacteria of the type of** *Bac. cereus* **Frankland pathogenic to insects.** [*In Russian.*]—*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **23** no. 3 pp. 26–27, 3 refs. Moscow, 1958.

A strain of sporulating bacteria of the type of *Bacillus cereus*, but differing from described strains pathogenic to insects, was isolated from a laboratory culture of *Galleria melonella* (L.) in the Soviet Union. Its characteristics are noted, and the name *B. cereus* var. *galleriae* is proposed for it. Mortality was 80–100 per cent. in three days when older larvae of *G. melonella* fed on food moistened with a suspension of the spores, and the strain also caused varying degrees of mortality of numerous other Lepidoptera infected in the same way; insects of other groups proved resistant. Good results were obtained in field tests in which a spray containing 6–10 million spores per ml. was applied to crops infested by larvae of several moths.

Vlasov (Yu. I.). **Mosaic disease of cabbage.** [*In Russian.*]—*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **24** no. 8 pp. 43–44. Moscow, 1959.

In tests in the Soviet Union, *Brevicoryne brassicae* (L.) proved an effective vector of the virus of cabbage mosaic when allowed to feed on infected and then on young healthy plants. The aphid is common on this crop in the field, and its control is one of the measures recommended against the disease.

Goryushin (V. A.). **The epiphytotiology of sugar-beet yellows in the Ukraine.** [*In Russian.*]—*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **24** no. 10 pp. 31–36, 5 figs. Moscow, 1959.

Sugar-beet yellows, the symptoms of which are described, was observed, for the first time in the Soviet Union, in the Ukraine in 1956–57; a mild form of the virus appeared to be mainly involved, and numerous wild plants were found to be infected, in addition to beet. The principal insect vector was *Aphis* (*Doralis*) *fabae* Scop., and *Myzus* (*Myzodes*) *persicae* (Sulz.) was rare, though in tests it proved a more effective vector than *A. fabae*. Infection began in the field at the end of June or the beginning of July, at the time of aphid migration, and reached its maximum at the end of September. Control measures are discussed. In tests, good results were given by spraying against *A. fabae* with systemic insecticides, including schradan and demeton, as soon as the aphids appeared.

Zagulyaev (A. K.). **Moths as pests of fur and wool and their control.** [*In Russian.*]—194 pp., 2 col. pls., 64 figs., 4 pp. refs. Moscow, Akad. Nauk SSSR, 1958. Price 7 *rub.*

Moths are the most important pests of raw and manufactured fur and wool in the Soviet Union, and losses due to them are particularly severe in the south, where climatic conditions favour their activities. Control has been hindered by lack of knowledge of their bionomics, and the latter was largely due to difficulties in identifying the species concerned. These comprise *Tinea pellionella* (L.), *T. pallescentella* Stnt. (*coacticella* Zagul.), *T. trinotella* Thnb. (*lapella* Hb.), *T. columbariella* Wocke, *Niditinea* (*T.*) *fuscipunctella* (Haw.), *N.* (*T.*) *eurinella* (Zagul.) [which is considered by Petersen probably to be a synonym of *N. fuscipunctella*], *Tineola bisselliella* (Humm.), *T. furciferella* Zagul. [*R.A.E.*, A **43** 195], which may be only a biological form of *T. bisselliella*, *Monopis rusticella* (Cl.), *M. spilotella* (Tgstr.), *M. monachella* (Hb.), *M. imella* (Hb.), *M. nominella* Zagul. and *Trichophaga tapetzella* (L.). The general morphology of all stages of these Tineids is reviewed, and keys to them based on external characters and on the genitalia of the males and females are given, followed by notes on the characters, distribution, economic importance and control of the individual species, and general accounts of their bionomics and food relations.

Tinea pellionella, *Tineola bisselliella* and *T. furciferella* are restricted to indoor habitats in temperate climates, but the other species also breed in the field, in the nests of birds, the burrows of rodents and other places, which serve as constant sources of infestation. Protective measures include cleanliness, proper maintenance of storage facilities, frequent inspection, and proper control of imported goods to exclude species not occurring in a given area; *T. pallescentella* was introduced into the Union with products from Mongolia and has become established in Moscow and Leningrad. Control methods comprise mechanical measures and the use of repellents or insecticides. Mitin (sodium salt of N-(3,4-dichlorophenyl)-N′-2-(2-sulpho-4-chlorophenoxy)-5-chlorophenyl-urea) is the best material for use in impregnation [*cf.* **42** 289] but has not so far been tested in the Union. Other materials, including DDT, can be used as contact insecticides, and various fumigants are also effective; the properties and uses of all these are discussed, with reference to both commercial and domestic conditions, and methods of applying them described.

Ruzaev (K. S.). **Materials on the bioecology of *Otiorrhynchus turca* Boh.** [*In Russian.*]—*Zool. Zh.* **37** pt. 6 pp. 855–865, 1 graph, 14 refs. Moscow, 1958. (With a summary in English.)

Otiorhynchus turca Boh. is an important pest of vines on the Black Sea coast of the North Caucasus [*cf. R.A.E.*, A **4** 297; **27** 43], and observations were carried out on the effect of ecological factors on it. These showed that temperatures above 33°C. [91·4°F.] and below −10°C. [14°F.] are lethal to the adult weevils, the optimum for activity occurring at 15–23°C. [59–73·4°F.] and that for oviposition at 16–20°C. [60·8–68°F.]. At a relative humidity of 90–100 per cent., the optimum temperature range for the eggs was 18–20°C. [64·4–68°F.], and no embryonic development occurred at relative humidities of less than 80 per cent. The optimum temperature range for the larvae was 12–20°C. [53·6–68°F.], and the threshold for both eggs and larvae was 7°C. [44·6°F.]. Thermal constants for development are given.

Zhukovskiĭ (A. V.). **The problem of the diapause of the larvae of the Hessian fly.** [*In Russian.*]—*Rev. Ent. URSS* **36** pt. 1 pp. 28–43, 1 fig., 36 refs. Moscow, 1957. (With a summary in English.)

Investigations on the diapause of *Mayetiola destructor* (Say) on cereals in the central black-soil region of the Soviet Union [*R.A.E.*, A **41** 10] were continued until 1955. Adults of the overwintering generation emerge between late April and the end of May, and larvae of the first generation form their puparia between late May and mid-June. In the springs of 1925, 1952 and 1955, when temperatures during the larval feeding period were unusually low, the percentages of larvae entering diapause were 10, 1·3 and 4, respectively, and in 1938 and 1949, when they were higher, the percentages were 80 and 62. There was no relation with rainfall, and observations on puparia formed at various times during the springs of 1938, 1952 and 1953 showed that those containing larvae that had developed early in the season, at low temperatures, gave rise to adults without diapause, while those containing larvae that had developed later, at high temperatures, underwent diapause and did not give rise to adults until the autumn. Adults that emerged in summer gave rise to larvae that developed at high temperatures and entered diapause. The adults from these did not emerge until the second half of September, and their offspring were killed by low winter temperatures before they were able to form puparia. First-generation adults from diapause larvae oviposited in late August and early September, before the onset of cool weather, and their progeny overwintered. In 1952 and 1955, when almost all the first-generation larvae developed without diapause, there was a mass emergence of adults in summer, and large numbers of puparia were formed, but these gave rise to adults towards the end of September, when cold weather had begun and their offspring did not survive. Mass emergence in summer thus indicates that the overwintering population will be small. There are not more than two full generations a year.

In 1949, when most of the first-generation larvae underwent diapause in the field, the diapause was terminated in the laboratory by keeping the puparia in immediate contact with water [*cf. loc. cit.*]; in 1952, when most of them developed without diapause, contact with water failed to interrupt the diapause of the remainder. A negative result was again obtained in 1955, the diapause lasting in some cases until the following spring.

In experiments in the winter of 1949–50, puparia collected from winter wheat on 22nd October were kept in the laboratory at natural spring temperatures varying from 20°C. [68°F.] at midday to 10°C. [50°F.] at night. Adult emergence began on 19th November and continued until 20th December, by which time 6·6 per cent. of the adults had emerged, the rest of the larvae remaining in diapause. The larvae in diapause were divided into batches of 50, of which some were kept in the open under natural conditions and others in the laboratory at spring temperatures. The former were kept from 3rd January until 5th April at high humidity (but not in contact with water) at 16–24°C. [60·8–75·2°F.] or 10–20°C., and the latter were kept either in immediate contact with water or at high humidity (but not in contact with water) at 16–24°C. or 10–20°C. or without moisture at 10–20°C. From 5th April all the batches were kept at 18–20°C. [64·4–68°F.]. Of those kept in the open until January, 16 per cent. of the first batch gave rise to adults between 19th April and 8th May, the rest remaining in diapause, and 10 per cent. of the second batch gave rise to adults between 18th April and 3rd May, 36 per cent. failing to survive and 54 per cent. remaining in diapause. Of those kept at spring temperatures until January and then at 16–24 or 10–20°C. in contact with water, 46 and 76 per cent. gave rise to adults, the first batch between 26th January and 5th May and the second between 15th March and 10th May; 44 per cent. of the first lot died and the remainder gave rise to adults on 15th September, and the rest of the second lot remained in diapause. Of the similar batches kept at high humidity, 16 per cent. of those at 16–24°C. gave rise to adults, between 16th March and 26th April, 34 per cent. dying and the rest remaining in diapause, and 88 per cent. of those at 10–20°C. died, the rest remaining in diapause. All those kept at 10–20°C. without moisture died.

In June and July 1950, puparia from the autumn generation of 1949 were found containing larvae still in diapause, and some of these did not give rise to adults until the autumn of 1950. It is concluded that diapause is a normal part of the development of all generations of *M. destructor*. It is induced by high temperatures during the larval feeding period and can be terminated in some cases by keeping the puparia in conditions of high humidity or in immediate contact with water.

KUZNETSOV (V. I.). **The bionomics and systematic status of the species of *Euzophera* injurious to pomegranate, apple and quince.** [*In Russian.*] —*Rev. Ent. URSS* **36** pt. 1 pp. 59–71, 3 figs., 25 refs. Moscow, 1957. (With a summary in English.)

Two species of *Euzophera* have been recorded as injurious to fruits in Transcaucasia and Central Asia, *E. bigella* (Zell.) on apple and quince [*cf. R.A.E.*, A **34** 156, etc.] and *E. punicaella* (Moore) on pomegranate.

E. bigella was originally described from Italy, and little is known of its habits in western Europe; it has not been reported as a pest there. *E. punicaeella* was described from Baluchistan, where it has been recorded as injurious to apple and pomegranate [*cf.* **32** 406, etc.]. With the increased cultivation of pomegranate in Central Asia since 1937–38, damage ascribed to *E. punicaeella* has increased in importance, especially in south-western Turkmenia, and investigations on the specific identity and bionomics of this Pyralid were carried out in 1952–53. These showed that in addition to being a severe pest of pomegranate, destroying up to 80 per cent. of the fruits in some orchards, it occasionally occurred in apples infested by *Cydia* (*Carpocapsa*) *pomonella* (L.), as has been recorded for *E. bigella*. Adults of the two are very similar in external appearance, and the genitalia of examples reared from pomegranate and apple, which are described, did not differ from those of individuals identified as *E. bigella* by Gerasimov [**19** 595]. A male from Italy in Wocke's collection, identified by him as *E. bigella*, resembled the moths from pomegranate externally, but differed in the genitalia. On the other hand, the Asiatic moths agreed with the description of *E. bigella* by Zeller and with the figures of this species given by several early authors. The known areas of distribution of the two overlap. Examination of Zeller's types would be necessary to decide whether *E. punicaeella* is a synonym of *E. bigella*, and, until this can be done, it is concluded that records of *E. bigella* in Soviet Asia should be referred to *E. punicaeella*.

The observations on the bionomics of *E. punicaeella* showed that the larvae attack both the inner bark and the fruits of pomegranate, old trees being preferred. The adults of the overwintering generation emerged during the first third of May. The females laid eggs on the bark, preferring branches near the ground, and the larvae penetrated the bark and fed on the bast during May and June, forming galleries in it and causing the branch to wither. The resulting adults oviposited on both bark and fruits, if these were sufficiently ripe, thin-skinned varieties being preferred. Larvae that hatched on fruits entered at the blossom end and fed inside, several being found in one fruit, often in the rind or just beneath it. A brown patch appeared on the surface of the fruit, usually near the blossom end, and cracks developed in this, affording entry to the larvae of subsequent generations. The larvae of the overwintering generation developed in October–November and hibernated beneath the bark or in the fruits. In 1953, the first injured pomegranates were observed on 20th July, the larvae in them pupating in late August. There appeared to be two generations in the fruits in that year. Wild pomegranates are common in the area and doubtless serve as the source of the infestation.

Parasites reared from the larvae were identified as *Bracon* (*Habrobracon*) *brevicornis* Wesm., *Mesostenus transfuga* Grav., *Elasmus* sp. and *Fischeria* sp. For control, injured fruits should be collected regularly and destroyed, the trunks of the trees lime-washed once a year and wounds painted. Old trees should be cut down, and thick-skinned varieties of pomegranate that are less liable to attack planted wherever possible.

Bogush (P. P.). **Parasites of the cotton bollworm,** *Chloridea obsoleta* **F., reared in Turkmenia.** [*In Russian.*]—*Rev. Ent. URSS* **36** pt. 1 pp. 98–107, 3 refs. Moscow, 1957. (With a summary in English.)

The following is based largely on the author's summary. *Heliothis armigera* (Hb.) (*Chloridea obsoleta*, auct.) has increased in importance as a pest of cotton and other crops in Turkmenia since 1949, and investigations on it were begun in 1952. These included the rearing of larvae collected from the various crops, and note was kept of the parasites that emerged. A list of these is given, supplemented by a few reported earlier, with records of locality, date and the crops concerned and sometimes notes on bionomics. Of all the 22 parasites recorded, the most important were *Bracon* (*Habrobracon*) spp. (*B. brevicornis* Wesm., *B. hebetor* Say, *B. simonovi* (Kok.) and *B. turkestanicus* (Telenga)), which also parasitise the larvae of *Spodoptera* (*Laphygma*) *exigua* (Hb.) and are favoured by the early appearance of the latter on cotton. Of the endoparasites the most important were a species of *Therion* (*Exochilum*) on cotton and lucerne, *Litomastix* sp. on lucerne, tomato and chick-pea and *Apanteles kazak* Telenga on tomato. In 1953, when attack by *Heliothis armigera* was unusually light, 61 per cent. of 126 larvae collected from lucerne were found to be parasitised, but in 1954, when attack was heavier than ever before, the percentage parasitised among 600 first-generation larvae was only 16.

MATSUMOTO (S.), OKUBO (T.), UYEDA (I.) & TORIKAI (Y.). **Studies on organophosphorus insecticides. II. Effect of mineral carriers on deactivation of organophosphorus dust formulation.** [*In Japanese.*]—*Botyu-Kagaku* **22** no. 4 pp. 327–332, 3 graphs, 6 refs. Kyoto, 1957. (With a summary in English.)

Some organic phosphorus insecticides, such as methyl-parathion and malathion, show marked decomposition when formulated on certain commercial mineral carriers used in the preparation of dusts. The extent and rate of decomposition, which are functions of the catalytic activity of the carriers, can be controlled by chemical treatment of the latter. The investigations described showed that the surface acidity of various mineral carriers was correlated with the stability of organic phosphorus insecticides formulated on them, and that carriers with high surface acidities cannot be used to prepare stable formulations without proper deactivation. The use of several non-ionic surface-active agents in the formulations conferred stability. Organic phosphorus insecticides and non-ionic surface-active agents are immiscible, but can be used to impregnate the carrier simultaneously from one tank by mixing with a co-solvent, such as benzene.

HUKUSIMA (S.). **Ecological studies on the peach fruit moth,** *Carposina niponensis* **Walsingham. V. On the induction of the larval diapause and recovery from it in the peach fruit moth.** [*In Japanese.*]—*Botyu-Kagaku* **22** no. 4 pp. 370–378, 3 graphs, 19 refs. Kyoto, 1957. (With a summary in English.)

In this fifth part of a series [*cf. R.A.E.*, A **48** 47], it is stated that *Carposina sasakii* Mats. (*niponensis* Wlsm.), one of the most destructive pests of apple in Japan, overwinters in the larval stage in a cocoon in the soil and has two overlapping generations a year, adult emergence beginning in mid-June and in late July or early August, respectively, in northern districts [*cf.* **19** 602; **24** 628]. Larvae of the first generation that do not hatch until August may, however, enter diapause immediately and remain in it until favourable conditions return, and experiments were carried out in 1955–57 to find the environmental factors influencing the inception and termination of diapause.

Transferring larvae of the first generation from 23–26°C. [73·4–78·8°F.] to 15–20°C. [59–68°F.] immediately after completion of the egg, early larval or late larval stage showed that both the proportion of larvae entering diapause and the weight of the larva in diapause increased with the length of exposure to the lower temperature. When the insects were kept throughout the egg and larval stages at 15–20°C. or 20–25°C. [68–77°F.], and the daily period of light was varied, the numbers that entered diapause reached peaks at photoperiods of about 14 and 11 hours, respectively.

When larvae in diapause, of either generation, were kept from mid-November to mid-January at fluctuating outdoor temperatures and were then transferred to 25°C., adult emergence soon followed, and when they were transferred to 25°C. after being kept at 5°C. [41°F.] for 25–95 days, the percentage emergence increased as the period at low temperature was prolonged, with no noticeable difference between the generations. Observations on larvae in diapause kept at constant temperatures varying from −2 to 30°C. [28·4 to 86°F.] for 55 days and then transferred to 25°C. for three months showed that temperatures of 0–20°C. [32–68°F.] caused the termination of diapause and that 5°C. was the most favourable.

Common (I. F. B.). **A revision of the pink bollworms of cotton** (*Pectinophora* **Busck** (**Lepidoptera: Gelechiidae**)) **and related genera in Australia.**—*Aust. J. Zool.* **6** no. 3 pp. 268–306, 1 pl., 9 figs., 25 refs. Melbourne, 1958.

The Australian representatives of four genera of Gelechiids of which the larvae apparently feed in the seed capsules of cotton or other malvaceous plants are reviewed. Although Busck pointed out differences in the genitalia, Meyrick considered *Pectinophora* (type species *Depressaria gossypiella* Saund.) to be congeneric with *Platyedra* (type species *Gelechia vilella* Zell.), and his opinion was followed by economic entomologists in the Old World, who used the name *Platyedra gossypiella* for the well-known pink bollworm of cotton. The author distinguishes *Pectinophora* from *Platyedra* on genitalic and other characters, gives a key for the separation of *Pectinophora* and the three other genera, two of which are new, discusses characters separating related genera not represented in Australia (of which *Platyedra* is one), and describes numerous species, including many new ones, giving notes on their distribution and also on their food-plants, when known. The species of *Pectinophora* are *P. gossypiella*, which damages cotton in north-western Australia and specimens of which were also examined from Egypt, India, Hawaii and the United States; *P. scutigera* (Hold.), which is a minor pest of cotton in Queensland and is also recorded from the Northern Territory (though the record from that area needs confirmation) and from Papua and Micronesia; and *P. endema*, sp.n., which occurs in Queensland and New South Wales and has been reared from *Hibiscus* spp. but not so far from cotton. A key to these three is included. One of the new genera is *Pexicopia*, and *Platyedra malvella* (Hb.), a European species, is transferred to it.

Stuart (A. M.). **A review of work in New Zealand on the clover case-bearers** *Coleophora spissicornis* **Haw. and** *C. alcyonipennella* ? **Kollar (Coleophoridae, Lep.).**—*N.Z. J. agric. Res.* **1** no. 2 pp. 239–248, 4 figs., 9 refs. Wellington, N.Z., 1958.

Two species of *Coleophora* are known to be of economic importance on seed crops of white clover (*Trifolium repens*). These are *C. spissicornis* (Haw.), which occurs in the United States, Australia, Tasmania and New

Zealand [*cf.* *R.A.E.*, A **33** 184] and is native to Europe and Asia Minor, and another, hitherto misidentified as *C. frischella* (L.) in New Zealand and *C. deauratella* Zell. in Tasmania [*cf.* **41** 26] and also present in continental Australia, which, following recent examination of specimens from New Zealand, was tentatively identified as *C. alcyonipennella* (Koll.) by Bradley, who states that it is probably indigenous in Europe. An account is given of observations on the bionomics of the two species in New Zealand [*cf.* **41** 26] and of work on their biological control there, together with descriptions of the last-instar larvae, figures of the genitalia of both sexes and accounts of the methods adopted for rearing in outdoor insectaries.

C. alcyonipennella is the commoner species. The adults, which are present from the end of October to the end of March and are most abundant in late December and January, feed on the nectar of *T. repens*, and the fertilised females deposit their eggs between the petals and calyx of the florets. The first-instar larva usually consumes all or part of one seed, the second-instar larva what is left of this seed, another one and sometimes part of a third, and the third-instar larva the remaining seeds in the pod and those in up to four others, webbing the florets together. The fourth-instar larva feeds on a few seeds and then constructs a case, by webbing the margins of the detached standard petal, which it later reinforces, especially if of the overwintering generation. After constructing their cases, the larvae feed in more than one floret and, when fully fed, pupate either immediately, after sealing the cases to the withered flower heads, or, especially in the later generations, after migrating for some distance. No adults emerged from hibernating larvae collected in winter, but it is thought that such larvae pupate and give rise to adults in November. Development lasted 48–58 days between December and February in the outdoor insectary, but was completed in six weeks by the first generation in the field and probably in 4–5 weeks by the summer generation. Field-collected adults survived for 1–2 weeks in the insectary, and there are probably about 4–5 generations a year. Eggs are also laid on strawberry clover (*T. fragiferum*), which flowers later than *T. repens*; the life-cycle on this food-plant is in general similar, but differs in the number of seeds consumed, since there is only one per pod, the greater use of the calyx in the construction of the case, and the delayed formation of its case by the last-instar larva. *C. spissicornis*, adults of which are present from November to January and are most numerous in December, is known only from *T. repens* in New Zealand. In the outdoor insectary, development lasted 5–6 weeks and the adults survived for about two weeks. There is apparently only one generation a year.

In 1950, work on parasites that attack *C. spissicornis* and *C. frischella*, which was at that time thought to be the species present in New Zealand, was begun in Belgium and France with a view to introducing suitable species into New Zealand. Because *C. spissicornis* was difficult to find, attention was concentrated on the species identified as *C. frischella*, and, early in 1952, 9,000 parasitised larvae were received in New Zealand, where most were liberated in March, before the parasites had emerged. In addition, 200 adults of *Habrocytus milleri* Delucchi & Verbeke were liberated at a place in the North Island and several hundreds of this hyperparasite and 100 of *Bracon osculator* Nees, another hyperparasite, at one in the South Island in February 1953. Work was then discontinued until 1955, when differences were noted in the habits of the species identified as *C. frischella* in Europe, where *Melilotus altissima* was the main food-plant and the one from which the parasitised larvae were collected, and in New Zealand, where it did not feed on this plant, and this led to the discovery of its misidentification. In

November 1955, 5,000 parasitised larvae of *C. frischella* were received from Europe [*cf.* **45** 418], but the few parasites that emerged did not attack New Zealand material, and work in Europe was then discontinued. The diapause of these larvae could not be broken, even by exposure to temperatures of 5 and 10°C. [41 and 50°F.] for as much as 12 weeks, and many were still alive two years later. If *C. spissicornis* and *C. alcyonipennella* resemble *C. frischella* in having a flight period of four weeks in June–July, followed in the next generation by a larval diapause lasting several months, there is little hope of rearing parasites unless a means of eliminating diapause or terminating it more quickly can be found.

HILLE RIS LAMBERS (D.) & MACGILLIVRAY (M. E.). **Scientific names of potato-infesting aphids.**—*Canad. Ent.* **91** no. 6 pp. 321–328, 61 refs. Ottawa, 1959.

TAYLOR (C. E.). **Nomenclature of the common potato aphids (Hem., Aphididae).**—*Ent. mon. Mag.* **94** no. 1131 pp. 169–170, 6 refs. London, 1958.

The first of these papers was written to co-ordinate the names used for common species of aphids that infest potato in Europe and North America. Only the most important synonyms are considered. *Aphis abbreviata* Patch was found by examination of cotypes to be a synonym of *A. nasturtii* Kalt., which has been misidentified as *A. rhamni* Boy.; the true *rhamni* is a species of *Macchiatiella*. *Myzus convolvuli* (Kalt.) is a synonym of *M. persicae* (Sulz.), and *Macrosiphum solanifolii* (Ashm.) and *M. koehleri* Börn. are synonyms of *M. euphorbiae* (Thos.) (*gei*, auct.). The remaining species are *M.* (*Aulacorthum*) *solani* (Kalt.) (*pseudosolani* (Theo.)), which has been misidentified as *Myzus convolvuli*; *Smynthurodes betae* Westw., of which *Trifidaphis phaseoli* (Pass.) is a synonym; and *Rhopalosiphoninus latysiphon* (Davidson), which is becoming economically important in Europe.

The author of the second paper discusses the nomenclature of four species that are common on potato in Britain. They are *Myzus persicae*, *Macrosiphum euphorbiae* (for which, following Börner, he uses the name *M. solanifolii*), *M. solani*, and *Aphis* (*Aphidula*) *nasturtii*.

MACDONALD (D. R.). **Biological assessment of aerial forest spraying against spruce budworm in New Brunswick. III. Effects on two overwintering parasites.**—*Canad. Ent.* **91** no. 6 pp. 330–336, 2 graphs, 12 refs. Ottawa, 1959.

This part of a series [*cf. R.A.E.*, A **48** 142, etc.] contains the results of observations in 1952–58 on the effect of the DDT sprays applied by aircraft against the spruce budworm [*Choristoneura fumiferana* (Clem.)] on balsam fir [*Abies balsamea*] in New Brunswick on two of the more abundant parasites of the larvae. During this period almost all the forest areas in northern New Brunswick were treated with DDT, mostly at 0·5 lb. in 0·5 U.S. gal. oil per acre; practically all areas were treated at least twice, part of the original outbreak area was treated five times, and an experimental plot was sprayed every year. The parasites were *Apanteles fumiferanae* Vier. [*cf.* **36** 240] and *Glypta fumiferanae* (Vier.) [*cf.* **36** 255], which oviposit in *C. fumiferana* in late summer, overwinter in the larvae in their hibernacula and are almost the only species found in the third- and fourth-instar host larvae. The fully grown *Apanteles* larvae emerge from their hosts and construct cocoons on the branches about the last two weeks of June, when spraying is usually carried out, but peak cocoon formation by *Glypta* occurs after spraying, in the second and third weeks of July.

Sampling at different times in the year showed that parasitism by *Apanteles* followed the same trend in sprayed and unsprayed areas, but was usually considerably lower in the latter, where it rose from less than 1 per cent. in 1952 to about 8 per cent. in 1954 and, after falling to 1 per cent. in 1956, rose to 13 per cent. in 1958; in that year, it ranged up to 23 per cent. in treated areas, being highest in those most frequently sprayed. Parasitism by *Glypta* in general decreased from about 5–8 per cent. in 1952–54 to less than 4 per cent. in 1956–58, and was almost always higher in unsprayed than in sprayed plots; the parasite was not recovered at all from four of ten sampling areas, including one unsprayed one, in 1958. The same trends were also apparent from assessments of parasitism in the year following spraying. In 1955 and 1957, parasite numbers before and one week after spraying were compared by means of samples of host larvae and parasite cocoons from the branches and of host larvae that were affected by the spray and had fallen from the trees on to cloth trays beneath them. Parasitism by *Apanteles* amounted to 7–10 per cent. before spraying, but was as high as 14–37 per cent. among the few surviving larvae on the branches after it; among the few larvae knocked down by the spray but still living it averaged 3·9, and among the numerous dead larvae it was 2·6 per cent. Parasitism by *Glypta* ranged from 1·3 to 4·4 per cent. before and from 0·5 to 3·9 per cent. after spraying, but after treatment there were no consistent differences between parasitism on the branches and on the ground and, among the latter, between living and dead larvae. The high survival rate of *Apanteles* is attributed to the formation of cocoons by some larvae before the application of the sprays, to the reduced activity of moribund larvae containing almost mature parasite larvae and consequent less likelihood of contact with insecticide deposits, and to the ability of some parasite larvae, evidently advanced in development at the time of spraying, to emerge from hosts knocked down by the spray. It is concluded that neither parasite is likely to be eliminated by sprays applied at the dosage and with the technique employed in New Brunswick.

A steady decline in parasitism by *Glypta* has also been observed elsewhere towards the end of outbreaks of *C. fumiferana*. In 1957, egg populations of the Tortricid showed a decrease, which was continued in 1958, and in the latter year, parasites other than *Apanteles* and *Glypta* showed a substantial increase in effectiveness. These were mainly *Meteorus trachynotus* Vier. and *Angitia* (*Horogenes*) *cacoeciae* (Vier.). The latter characteristically parasitises populations of *C. fumiferana* at endemic levels, and the outbreak may therefore be approaching its end.

ARMSTRONG (T.). *Swammerdamia caesiella* **Hbn. (Lepidoptera: Yponomeutidae), a new pest of Japanese plum in the Niagara Peninsula, Ontario.**—*Canad. Ent.* **91** no. 6 pp. 340–345, 1 fig., 3 refs. Ottawa, 1959.

The following is based partly on the author's summary. The European Hyponomeutid, *Swammerdamia caesiella* (Hb.), all stages of which are briefly described, has become established in orchards of Japanese plum (*Prunus salicina* and its hybrids) in the eastern half of the Niagara fruit belt in Ontario, where it also attacks myrobalan plum (*P. cerasifera*) and its ornamental variety, *P. c. pissardii*, but not European plum (*P. domestica*).

It feeds largely on the leaves and has so far been of little economic importance. The larvae overwinter in the second instar in shelters on the trunk and older twigs and branches and feed on the foliage and blossom clusters in late April and May. There are two generations and a partial third in the year. About 65 per cent. of the larvae of the second generation and all of the third overwintered in 1957. In cages, the adults survived for 8–13 days, and the females laid up to 248 eggs singly on the lower surfaces of the leaves. Eggs hatched in 8–31 days. The larvae bore directly through the chorion into the leaves and feed as leaf miners during the first instar. After the first moult, they leave the mines and skeletonise the leaves from the lower surfaces. The larval period of the summer generations varied from 17 to 38 days, and the pupal period from eight to 24. Pupation occurs in cocoons on the leaves and bark. Seven species of parasites, including *Angitia* (*Horogenes*) *obliterata* (Cress.), were reared from 826 mature larvae and pupae, but parasitism was extremely light. A dormant spray containing 2 lb. 40 per cent. wettable DNC per 100 gal. applied to a heavily infested orchard on 28th March gave 97 per cent. mortality and prevented populations from rising above a relatively low level throughout most of the summer, though hibernacula were numerous by October. A spray of 1·5 lb. 15 per cent. wettable parathion per 100 gal. applied on 24th April, when 24 per cent. of the larvae had left their hibernacula, gave complete mortality and, except where only part of an orchard was sprayed, complete protection throughout the season. Two applications of parathion, applied at the shuck-split stage and ten days later, as against *Conotrachelus nenuphar* (Hbst.), was of no value, because the many pupae present were unaffected.

George (J. A.) & Davidson (T. R.). **Notes on life-history and rearing of** *Colladonus clitellarius* (**Say**) (**Homoptera: Cicadellidae**).—*Canad. Ent.* **91** no. 6 pp. 376–379, 6 figs., 5 refs. Ottawa, 1959.

The bionomics of *Colladonus clitellarius* (Say), the nymphs and adults of which are briefly described and which has been found to be a vector of the virus causing eastern X-disease of peach and cherry, were studied in the Niagara Province of Ontario in 1957 and 1958 to facilitate the rearing of sufficient numbers for virus-transmission tests. The Cicadellid was found to have two generations a year and to pass the winter in the egg stage among fallen leaves. The overwintered eggs hatched between 21st April and 10th May; adults of this generation were collected from late May or early June until early July, and first-generation adults from the first week in August until about the last week in October. The adults feed, and the females oviposit, on the leaves of deciduous woody plants. Adults were commonest on boxelder (*Acer negundo*), but also occurred on mazzard cherry (*Prunus avium*), willow (*Salix* sp.), lilac (*Syringa vulgaris*), wild grape (*Vitis riparia*) and chokecherry (*P. virginiana*). In rearing cages, they survived for eight weeks on *A. negundo*, but for only a week on sour cherry (*P. cerasus*) and only ten days on dandelion (*Taraxacum officinale*), a preferred food-plant of the nymphs. The eggs are laid between the upper and lower epidermis of the leaf, usually along its edge, and in rearing cages were deposited on boxelder, sour cherry, wild grape and nightshade (*Solanum dulcamara*). On hatching, the nymphs fall to the ground and feed mostly on herbaceous plants, mainly dandelion, nightshade and prickly lettuce (*Lactuca serriola* (*scariola*)). A yellow necrotic area develops round the feeding puncture, increases in size as feeding continues, and may eventually affect the whole leaf. The average development period was about 31 days at 70°F. An unidentified Dryinid parasitised the nymphs of the first, but not of the overwintered, generation, and prevented them from completing their development. Many nymphs are destroyed by spiders. *C. clitellarius* was readily reared in the greenhouse when boxelder seedlings were provided as food for the adults and dandelion or nightshade seedlings for the nymphs.

SMIRNOFF (W. A.) & BÉIQUE (R.). **On a polyhedral disease of *Trichiocampus viminalis* (Fall.) larvae (Hymenoptera: Tenthredinidae).**—*Canad. Ent.* **91** no. 6 pp. 379–381, 2 figs., 1 ref. Ottawa, 1959.

Trichiocampus viminalis (Fall.), which is indigenous in Europe, also occurs in the north-eastern United States [*cf. R.A.E.*, A **26** 17], eastern Canada and British Columbia [*cf.* **14** 174], and during the past 5–6 years has seriously defoliated poplars (*Populus nigra* and *P. deltoides*) near Quebec city. Studies on its bionomics there showed that the sawfly has two generations a year, one between the end of May and the end of August, and the other between the end of August and about mid-October. The eggs are laid in the petioles, and the larvae feed gregariously from the lower surface of the leaves. Pupation takes place in cocoons in the soil. Between 20th and 30th July 1957, widespread larval mortality occurred almost simultaneously in all the areas under observation near Quebec, the dead larvae being found either under the trees or glued to the leaves. On examination of moribund larvae, polyhedral bodies were found in the epithelium of the midgut. It was estimated that only about 20 per cent. of the first-generation larvae completed their development, and though the adults to which they gave rise laid eggs, the larvae that hatched from them died in $1\frac{1}{2}$–2 weeks. In the spring of 1958, females oviposited on poplars planted in the greenhouse, but all the resulting larvae died of polyhedrosis in 6–10 days. A survey in the summer of 1958 showed *T. viminalis* to have practically disappeared from the main foci of infestation. Mortality was shown to be due solely to the virus, which is the first to be recorded attacking this sawfly. Infected larvae stop feeding after 2–3 days, gradually disperse, and change in colour from green to ivory yellow; after about 90 hours, the nuclei of the midgut are usually full of well developed polyhedral bodies. In a laboratory test in September 1957, a suspension prepared from dead larvae was injected orally into second- and third-instar larvae from uninfected districts at a rate of one drop per larva. The larvae ceased feeding after 24 or 48 hours, changed colour after 48 hours, and died after 96. In May 1958, a suspension of the virus at a concentration of 100,000 polyhedra per ml. caused complete mortality in 7–8 days when brushed on to newly deposited eggs or on to leaves that were fed to first-instar larvae; infection spread to the control larvae, which all died within 14–19 days.

DILLON (L. S.). **Reproductive isolation among certain spider mites of the *Tetranychus telarius* complex, with preliminary systematic notes.**—*Ann. ent. Soc. Amer.* **51** no. 5 pp. 441–448, 10 figs., 9 refs. Washington, D.C., 1958.

In view of the results of investigations on the ecology and life-history of various geographical strains of Tetranychids, cross-breeding experiments were carried out with 16 strains of mites referable to the composite species, *Tetranychus telarius* (L.), as interpreted by Pritchard & Baker [*R.A.E.*, A **44** 19]. These comprised green forms from New York, Ohio, New Jersey, Virginia, Texas, Arizona, Washington and California, red forms from

Maryland, Mississippi, Texas and California, and green and red forms from both England and Germany. The criterion of interfertility was the production of females. In all, 66 matings were made between green forms in 12 different combinations, including reciprocal crosses. Some females were produced in crosses between European and American forms, but only 14 of the 140 were normal, the rest being sterile or giving rise to males only, even though paired with sibling males; the males produced numbered 530. When green forms from Ohio, Texas and Virginia were mated with each other, the progeny comprised 121 males and 635 females, all of which produced normal offspring. In 81 attempts to hybridise green with red forms, only 45 female progeny resulted, as compared with 635 males, and only one of them laid eggs, all of which developed into males; in general the females in these crosses laid unusually few eggs, and the results were in close agreement with those of Boudreaux [**46** 261]. In 79 tests with red forms, few females were produced except when females from Mississippi were paired with males from Texas, and only the progeny of the latter were fertile; the poor hatching of the eggs produced from the other combinations indicated cytological incompatibility between ovum and sperm. The remaining test comprised matings of a strain from Virginia with strains from the west of the United States. Females were produced in somewhat greater numbers than males, but the sex ratio was far from normal; 20 per cent. of the F_1 females proved to be sterile when paired with F_1 males, and the remainder laid mostly non-fertilised eggs.

Since the results of these tests indicated specific differences between the various populations, morphological characters that might serve to distinguish them were sought. A new character of possible specific value was found in the structure of the subgenital pit of the female, which promised to facilitate identification of species from the females only. The differences were small however, and identification from the male genitalia proved more reliable, though high magnification and critical illumination are required; the shape of the tip of the aedeagus seemed remarkably constant for the forms studied.

On the basis of the information obtained, the mites are classified in two morphological groups, the first having reddish summer females and no overwintering ones and the other having whitish, pale amber or greenish summer females and orange overwintering ones. The mites in the first group are named *Tetranychus multisetis* McG., which is recorded from Orange, Riverside and San Bernardino Counties, California, *T. marylandicus*, sp.n., from Beltsville, Maryland, and possibly also from Blacksburgh, Virginia, *T. australis*, sp.n., which is widely distributed throughout Texas and east to Mississippi and for which the popular name 'southern red spider mite' is suggested, *T. lobosus* Boudreaux [**46** 261], from Louisiana and possibly from Durham, North Carolina, and *T. cinnabarinus* (Boisd.), which is composite and includes a British and a German species. Those in the second group are *T. telarius*, which also includes a British and a German species, and *T. bimaculatus* Harvey, consisting of a typical form, which is recorded throughout the United States, southern Canada and northern Mexico, east of the Rocky Mountains and their continuations, and subsp. *occidentalis*, n., from Albany, California, and Wenatchee and Yakima, Washington. The distinguishing characters of the females, males and larvae of all of these are described, with brief descriptions of the eggs of the species of the first group. The classification is based on the rather tenuous, though constant, morphological differences found and the strong evidence of the intersterility tests, and is stated to be further amply justified by differences in life-history, physiological responses, ecological requirements and distribution.

LANDIS (B. J.), GIBSON (K. E.) & SCHOPP (R.). **The iris whitefly in the Pacific Northwest.**—*Ann. ent. Soc. Amer.* **51** no. 5 pp. 486–490, 3 figs., 9 refs. Washington, D.C., 1958.

The observation of *Aleyrodes spiraeoides* Quaint. on potato in the Yakima Valley of Washington in 1941 [*R.A.E.*, A **37** 202] was the first from that crop and the first from an area north of California, where it had long been known to infest nursery and ornamental plants. Subsequently, it was observed on potato near Klamath Falls, Oregon, in 1945 and in southern British Columbia in 1950. Investigations on its bionomics were made, mostly at Yakima, in 1942–57, and the following is based on the authors' summary of the results. *A. spiraeoides* was found feeding on some 50 species of plants, including potato and several others of economic importance. The adults became active in March, and reproduction was general on hardy plants by the first part of May. The population increased steadily on preferred food-plants until August or September, and there were about five generations a year, lasting 21–45 days each. *Trialeurodes abutilonea* (Hald.) and *T. vaporariorum* (Westw.) were observed on potato in eastern Washington and western Idaho, respectively, and the immature stages of *A. spiraeoides* and *T. abutilonea* were attacked by a predator, *Geocoris pallens* Stål, and a parasite, *Encarsia coquilletti* How.

PRITCHARD (A. E.) & KEIFER (H. H.). **Two new species of *Bryobia* with a revised key to the genus (Acarina: Tetranychidae).**—*Ann. ent. Soc. Amer.* **51** no. 5 pp. 503–506, 7 figs., 17 refs. Washington, D.C., 1958.

A revised key based on the females is given for separating the species of *Bryobia* recognised by the authors as quite distinct morphologically, which include two described as new; species recorded from southern Russia are included on the basis of their descriptions only. No attempt is made to elucidate the complex of *B. praetiosa* Koch, which has recently received local study in several countries, but a list is given of names referable to it additional to those recorded by Pritchard & Baker [**44** 18]; these include *B. rubrioculus* (Scheuten) [**45** 86], *B. kissophila* van Eyndhoven [**45** 86], *B. berlesei* van Eyndhoven [**46** 318] and *B. arborea* Morgan & Anderson [**47** 118]. The new species are *B. spica*, from *Cytisus scoparius* in California, and *B. charai*, which occurs on chrysanthemum in Japan and Pakistan and was illustrated by Pritchard & Baker [**44** 18] under the name *B. cristata* (Dugès) [*cf.* **46** 318].

BUGBEE (R. E.). **A new species of *Eurytoma* Illiger, parasitic on the Nantucket pine moth, *Rhyacionia frustrana* (Comstock) and the European pine shoot moth, *R. buoliana* (Schiffermuller) (Hymenoptera: Eurytomidae; Lepidoptera: Olethreutidae).**—*J. Kans. ent. Soc.* **31** no. 3 pp. 197–200, 10 refs. Manhattan, Kans., 1958.

The author describes the adults of both sexes of *Eurytoma pini*, sp.n., from specimens reared in 1915 from *Rhyacionia* on *Pinus banksiana* and *P. sylvestris* at Washington, D.C., and misidentified as *E. tylodermatis* Ashm. Records of *E. tylodermatis* parasitising *R. frustrana* (Comst.) or *R. buoliana* (Schiff.) in the United States [*R.A.E.*, A **16** 141, 142; **21** 567; **24** 430; **32** 401] probably refer to the new species, which occurs wherever pine and *R. frustrana* are found, probably throughout the pine-growing regions of Canada and the United States. *E. pini* is apparently restricted to Lepidopterous larvae that mine in plant tissue, and has been bred from various species, including, in addition to *Rhyacionia* spp., *Thyridopteryx ephemeraeformis* (Haw.) in Maryland, *Eucosma* (*Epiblema*) *strenuana* (Wlk.) in Ohio and *Pectinophora gossypiella* (Saund.). It is an important primary ectoparasite of *R. frustrana*, but occasionally occurs as a secondary parasite. Emergence takes place mainly in June–August, but may begin as early as April (in Maryland) and continue until early September (in Ohio). Characters distinguishing it from *E. bolteri* Ril. and *E. tylodermatis* are described.

Roberts (J. E.) & Rolston (L. H.). **Corn earworm moth repellents.**—*J. Kans. ent. Soc.* **31** no. 3 pp. 200–202, 1 ref. Manhattan, Kans., 1958.

Since measures against the larvae of the corn earworm [*Heliothis zea* (Boddie)] on maize are usually effective against light infestations but sometimes fail against heavy ones [*cf. R.A.E.*, A **44** 124], the possibility of reducing the infestation potential by repelling the adults was investigated in Arkansas in 1955–56. It was found that females in cages with two muslin-covered openings were attracted to the light and oviposited freely on the muslin. In repellency tests, one of the muslin covers was dipped in a 10 per cent. solution of the desired chemical, and the numbers of eggs deposited on the treated and untreated covers after one night were used to estimate effectiveness. Of the 20 materials tested, N-butyl acetanilide, N-butyl lepidone, dimethyl phthalate, 2-butyl 2-ethyl 1.3-propanediol, Tat (a 3 : 1 mixture of dimethyl phthalate and dimethyl bicycloheptene dicarboxylate) and undecenoic acid showed considerable repellency two days after application, and the first three continued to reduce oviposition by about 50 per cent. for 25 days or more; 2-butyl-2-ethyl-1.3-propanediol lost effect more rapidly, and the other two were not tested after more than two days.

In a field test, a spray containing 10 per cent. technical N-butyl lepidone considerably reduced oviposition on the silks, but interfered with pollination; in the greenhouse, 1–5 per cent. sprays were phytotoxic. A 49·5 per cent. emulsion concentrate gave poor and inconsistent results in cage tests at concentrations of 0·25–6 per cent., and when added at 1 per cent. to a spray of DDT in mineral oil destroyed many ears and did not improve control in the field. A mixture of a 5 per cent. N-butyl lepidone dust with 10 per cent. DDT (3 : 1), applied to the silks, did not damage them but did not improve control.

In further tests, undecenoic acid showed significant repellency at 4–6 per cent., though not at 1–2 per cent., in the cage, but caused barely significant reductions in the numbers of eggs in the field, with severe scorching of the plants.

Jewett (H. H.), Henson (L.) & Fergus (E. N.). **Control of the tarnished plant bug, *Lygus lineolaris* (P. de B.), on red clover and alfalfa in Kentucky.**—*Bull. Ky agric. Exp. Sta.* no. 657, 10 pp., 3 refs. Lexington, Ky., 1958.

Average seed yields of red clover [*Trifolium pratense*], and probably also of lucerne, are low in Kentucky, and as *Lygus lineolaris* (P. de B.), which causes flower drop and browning and shrivelling of the seeds, occurs on these crops, though usually in small numbers, attempts were made to control it in stands reserved for seed production. Populations of *Lygus* were low.

In 1948, the application of 35 lb. 5 per cent. DDT dust per acre to lucerne and red clover in late June reduced the numbers of bugs present three days later by 67·2 per cent. and increased the yields of seed from 88·5 to 158·2 and from 77 to 101 lb. per acre, respectively, and in 1949, 32 lb. 5 per cent. dust reduced populations on red clover by 78·6 and 84·8 per cent. after two and nine days, respectively, and increased the yield from 241 to 306 lb. per acre. The statistical significance of the results could not be determined, and more detailed experiments were carried out in 1950–53. These showed that treatment with 8 oz. parathion, 10 oz. aldrin, 1 lb. DDD (TDE), 1·5 lb. DDT or 2 lb. toxaphene per acre in dusts in 1950 reduced the infestation significantly and tended to increase the yield, though the increases were not significant. Treatment with up to 6 oz. dieldrin, 8 oz. aldrin, heptachlor or lindane [almost pure γ BHC], 16 oz. chlordane, 4·8 oz. endrin or 1·5 oz. toxaphene in emulsion sprays in 1951–53 reduced infestation but did not increase yield, and it is concluded that populations of *L. lineolaris* are seldom large enough to depress seed yields in Kentucky and that efforts to control them are unwarranted. There were practically no honey bees in the crop and only small numbers of wild bees while the clover was in bloom in 1950–53, and yields are probably determined mainly by the number of pollinating insects present at flowering time.

Douglass (J. R.) & Hallock (H. C.). **Russian-thistle distribution in southern Idaho and eastern Oregon in relation to beet leafhopper populations.**—*Prod. Res. Rep. U.S. Dep. Agric.* no. 18, 20 pp., 8 figs., 6 refs. Washington, D.C., 1958.

The following is based on the authors' summary. The distribution of Russian thistle, *Salsola kali* var. *tenuifolia*, in southern Idaho and a small area of Malheur County, eastern Oregon, and its importance as a summer food-plant for the production of autumn populations of *Circulifer tenellus* (Baker) were investigated in 1934–54 [*cf. R.A.E.*, A **45** 271]. The weed covered less than one million of the 13 million acres examined, and 66 and 45 per cent. of the total area was in eastern Idaho in 1934 and 1939, respectively, and 31 and 46 per cent. in south-central Idaho; examination of four areas near cultivated land in south-central Idaho showed that it was most widespread in 1936–40 and 1949–52 and that the area of greatest abundance had moved westward in the interval.

Factors responsible for the fluctuation in abundance of the weed include the availability of seed, the amount of soil disturbance, the amount of vegetation consumed by animals, plant competition for soil moisture and the amount of rainfall at critical periods. *Salsola* was the first plant to appear on abandoned land, and was followed by several species of annual mustards (*Descurainia*, *Lepidium* and *Sisymbrium*) [*cf.* **46** 122] and then by *Bromus tectorum*, which is not a food-plant of *C. tenellus*.

Populations of the Cicadellid varied with the acreage of *Salsola*; 63 per cent. of the leafhoppers were produced in south-eastern Idaho in 1934 and 74 per cent. in the south-central area in 1938, and peak populations were recorded further west in 1949–52 than in earlier years. The numbers are sometimes reduced when *Salsola* is replaced by *B. tectorum*, but stands of this annual grass are not stable, and *Salsola* often becomes abundant in them after a few years. Perennial grasses, such as *Agropyrum cristatum*, have been sown and have reduced populations of *C. tenellus* by replacing its wild food-plants in a few areas.

STRUBLE (G. R.) & BEDARD (W. D.). **Arthropod enemies of the lodgepole needle miner,** *Recurvaria milleri* **Busck (Lepidoptera: Gelechiidae).**—*Pan-Pacif. Ent.* **34** no. 4 pp. 181–186, 3 refs. San Francisco, Cal., 1958.

Recurvaria milleri Busck is an important pest of lodgepole pine [*Pinus contorta*] in California and has numerous parasites and predators. A list of these is given, classified as species reared from the larvae or pupae, reared from infested foliage, collected in infested stands or found feeding on the larvae, together with another of those taken most often in the last two outbreaks, showing their frequency. Notes on some of the parasites are included.

MIDDLEKAUFF (W. W.). **A rose tip sawfly new to California (Hymenoptera: Tenthredinidae).**—*Pan.-Pacif. Ent.* **34** no. 4 p. 202, 1 ref. San Francisco, Cal., 1958.

Ardis sulcata (Cam.), a sawfly that is widely distributed in Europe and was recorded from Washington and Oregon in 1948 [*R.A.E.*, A **38** 31], was found boring in rose terminals in California in 1949 and subsequently identified among a collection of sawflies reared in that State in 1937.

BUTLER jr. (G. D.). **Braconid wasps reared from Lepidopterous larvae in Arizona, 1957.**—*Pan-Pacif. Ent.* **34** no. 4 pp. 221–223, 3 refs. San Francisco, Cal., 1958.

The Braconids recorded are *Apanteles marginiventris* (Cress.) from *Spodoptera* (*Laphygma*) *exigua* (Hb.) on cotton, *A. medicaginis* Mues. from *Colias eurytheme* Boisd., *A. militaris* (Walsh) from *S. exigua* on lucerne, *Apanteles* sp. from *Trichoplusia ni* (Hb.) on cotton, *Microplitis alaskensis* Ashm. from *T. ni* on cotton, lucerne and lettuce, *M. brassicae* Mues. from *T. ni* on cotton, *M. croceipes* (Cress.) from *Heliothis* spp. on various crops, *Chelonus texanus* Cress. from *S. exigua*, *S.* (*L.*) *frugiperda* (J. E. Smith), *Heliothis* sp. and *Prodenia ornithogalli* Gn. on various crops, *Rogas molestus* Cress. from *T. ni* on lucerne, and *R. perplexus* Gah. from *T. ni* on lucerne and *Heliothis* sp. on cotton.

MICHELBACHER (A. E.) & ORTEGA (J. C.). **A technical study of insects and related pests attacking walnuts.**—*Bull. Calif. agric. Exp. Sta.* no. 764, 86 pp., 82 figs., 4½ pp. refs. Berkeley, Cal., 1958.

This bulletin contains accounts of the bionomics, seasonal development, appearance of the various stages and control of the more important insects and mites that infest walnut in California, together with descriptions of the damage caused. The information is intended to facilitate field identification and that on control is confined largely to cultural measures and the effect of natural factors, as recommendations for insecticide treatment are continually changing. The species dealt with at most length are *Cydia* (*Carpocapsa*) *pomonella* (L.) and *Chromaphis juglandicola* (Kalt.), which are probably the most important pests. A section on the pests of stored walnuts is included.

GUNTHER (F. A.) & others. **Residual behavior of S-(p-chlorophenylthio)-methyl O,O-diethyl phosphorodithioate (Trithion) on and in mature lemons and oranges.**—*J. agric. Fd Chem.* **7** no. 1 pp. 28–30, 6 graphs, 4 refs. Easton, Pa., 1959.

The following is largely the authors' summary. Residues of Trithion on and in lemons and oranges from field-sprayed trees in California were determined by two methods. The apparent magnitudes and persistence of the residues as determined by a non-specific total-chloride method differed from those determined by a more specific colorimetric procedure, but the results were in general agreement with those for most other insecticides and acaricides on *Citrus* fruits, the degradation half-life being about a week on lemons and 2–3 weeks on navel oranges, according to formulation and concentration, and the persisting half-life about 2–3 and 5–6 weeks, respectively.

Malina (M. A.), Kearny (J. M.) & Polen (P. B.). **Determination of chlordan in air of habitations treated for insect control.**—*J. agric. Fd Chem.* **7** no. 1 pp. 30–33, 5 figs., 8 refs. Easton, Pa., 1959.

A method is described for the measurement of the minute quantities of chlordane that might be present in the air in houses treated for the control of insects. When it was applied to samples of the air from five houses in the eastern United States, the foundations of which had received various treatments with chlordane against termites, no chlordane was detected during the following six months, although the method is sensitive to as little as 0·005 part per million. It is concluded that chlordane used in this way presents no danger to health.

Irvine (J. E.) & Freyre (R. H.). **Occurrence of rotenoids in some species of the genus** *Tephrosia*.—*J. agric. Fd Chem.* **7** no. 2 pp. 106–107, 8 refs. Easton, Pa., 1959.

The following is virtually the authors' summary. Leaves, stems, roots, seeds and pods of 16 species of *Tephrosia* were successfully assayed for rotenoids, using a modification of the Gross-Smith red colour test. While 14 species contained some rotenoids, only five contained rotenoids in their leaves. *T. vogelii* had the highest leaf rotenoid content (ranging from 0·65 to 4·25 per cent.), and appears to be a prospective commercial source of rotenone and rotenoids.

Creamer (R. M.) & Lamont (T. G.). **Stability of certain insecticides in mixtures with fertilizers.**—*J. agric. Fd Chem.* **7** no. 2 pp. 107–111, 1 fig., 14 refs. Easton, Pa., 1959.

The following is substantially the authors' summary. Relatively few data are available on the stability of insecticides in mixtures with fertilisers, and the stability of mixtures of heptachlor, chlordane, aldrin, dieldrin, endrin, DDT and methoxy-DDT (methoxychlor) with a number of fertilisers was therefore studied at 30 and 100°C. [86 and 212°F.] using a chromatographic procedure to detect the appearance of degradation products and organic chlorine analyses to determine decreases in organic chlorine contents. Most mixtures had good stability for at least a month at 30°C., with losses of organic chlorine varying from negligible to more than 50 per cent. on aging for eight months. At 100°C., nearly all mixtures were unstable and lost about 20 per cent. of their organic chlorine in the first 24 hours. Instability of insecticides in fertiliser mixtures was related to minor characteristics of the fertiliser, such as iron content and surface acidity.

BURGES (H. D.). **A spear for sampling bulk grain by suction.**—*Bull. ent. Res.* **51** pt. 1 pp. 1–5, 1 pl., 1 fig., 2 refs. London, 1960.

The following is the author's summary. A light-weight spear has been developed to take samples of unlimited size from bulks of cereal grains. The spear is screwed on to lengths of narrow metal pipe, which are used to insert it into a bulk of grain. The sample is sucked out of the bulk through the pipe by the air stream of a domestic vacuum cleaner. This method largely overcomes the disadvantages inherent in other types of spear. The spear can be inserted into a bulk in any direction, even upwards. When sampling downwards, samples can be obtained from as deep as 9 m. Samples can be taken from directly against the walls of a store and as close as 1 cm. to the floor.

MUIR (D. A.). **A culture method for myrmecophilous root aphids.**—*Bull. ent. Res.* **51** pt. 1 pp. 7–8, 2 figs., 2 refs. London, 1960.

A method for culturing subterranean aphids was developed during investigations on ant colonies associated with them. A piece of the root or rhizome of the food-plant, grown in soil or a culture solution, is exposed and bent into a loop, which is inserted into a piece of glass tubing. The walls of the tube should be lined with plaster of paris, except for a strip left clear for observation, to minimise the risk of the aphids becoming trapped in condensation droplets. The aphids are introduced into the tube, the ends are plugged with cotton-wool and the whole is covered with a black plastic sleeve. Ant colonies are kept in the laboratory in two-chambered plaster nests, and, when required, the aphid cell is connected to an ant colony by means of rubber-jointed glass tubing with a bored stopper at each end. One of the stoppers is inserted into one end of the aphid cell after removal of the cotton-wool plug, and the other is inserted into a hole drilled through the wall of the plaster nest. Ant access is controlled by means of a plastic strip with a hole bored in it running in a slot cut in the plaster across the exit hole. Advantages of this method are that it causes minimum damage to the food-plant and that the cell can be connected to successive ant colonies or transferred to a new site without disturbing either the ants or the aphids.

VANDERPLANK (F. L.). **The availability of the coconut bug,** *Pseudotheraptus wayi* **Brown (Coreidae).**—*Bull. ent. Res.* **51** pt. 1 pp. 57–60, 2 refs. London, 1960.

The following is the author's summary. Reasons for the large day-to-day variations in the numbers of nymphs and adults of the Coreid bug, *Pseudotheraptus wayi* Brown, taken in the crowns of coconut palms in Zanzibar by the searching technique [*R.A.E.*, A **46** 415] over a period of six years were investigated in 1957–58. Data are given showing the results of searches (each occupying less than 20 minutes) carried out on two young palms at different times of day and night and in different weather conditions. For each successive two-hour period between 6.0 a.m. and 2.0 p.m. (in the case of nymphs) or 4.0 p.m. (in the case of adults) the proportion of searches in which *P. wayi* was observed was significantly greater on dull days than on bright, sunny days, but there were no such differences that were significant in respect of any other two-hour period for which comparisons could be made, except 4.0 to 6.0 p.m., when the proportion of searches disclosing nymphs was greater on bright days. During the hours of bright sunlight, the adults and nymphs hide in crevices and in the débris found in the leaf axils, but both remain in the open from dusk to dawn. During heavy rain they take shelter in dry crevices and niches. It is pointed out that this behaviour must be taken into consideration if the searching technique is used to assess the result of an application of insecticide.

GEERING (Q. A.) & COAKER (T. H.). **The effects of different plant foods on the fecundity, fertility and development of a cotton stainer,** *Dysdercus superstitiosus* **(F.).**—*Bull. ent. Res.* **51** pt. 1 pp. 61–76, 3 graphs, 20 refs. London, 1960.

The following is based mostly on the authors' summary. The ability of *Dysdercus superstitiosus* (F.) to utilise a much wider range of food-plants than was previously supposed [*cf. R.A.E.*, A **43** 401] and to complete a full breeding cycle on several diets other than cotton was demonstrated by rearing and breeding adults and nymphs in the laboratory in Uganda on immature seeds of sorghum, *Pennisetum typhoides*, maize and cowpea. Diets other than mature cotton seeds were less suitable for breeding, as judged by the fecundity of the females and the rate of development and the mortality of the nymphs, but the influence of nymphal diet on adult fecundity was not consistent. Females reared on sorghum were smaller than those reared on cotton seed and in some cases laid fewer eggs. Some indication was obtained that varieties of sorghum may differ in their suitability for producing maximum fecundity and egg viability. Those varieties to which the stainer exhibits a predisposition in the field may not be the most suitable. When adults were fed on cotton bolls 1–10 weeks old, the fecundity of the females and the rate of egg-production increased and the duration of the preoviposition period decreased with increasing age of the boll; the preoviposition period was also short when the females were fed on cotton seed that had been stored for a year. The removal of oil from cotton seeds somewhat reduced the fecundity of females fed on them, but had no effect on the rate of development of nymphs of the succeeding generation, though mortality in the first instar was increased. The fecundity of females that were fed on seeds that had been heated for an hour at temperatures of 30–190°C. [86–374°F.] was significantly reduced at the higher temperatures and the viability of the eggs was affected, but the rate of development of the nymphs to which they gave rise was not reduced, though mortality in the second instar was high. When the seed was treated for two hours at 50–190°C. [122–374°F.], the nymphs were able to survive only on seed heated at 50 and 100°C. [122 and 212°F.].

RIVNAY (E.). **The life-history of the melon weevil,** *Baris granulipennis* **(Tourn.), in Israel.**—*Bull. ent. Res.* **51** pt. 1 pp. 115–122, 1 pl., 2 graphs, 4 refs. London, 1960.

The following is based mainly on the author's summary. *Baris granulipennis* (Tourn.), which was originally described from Egypt [*cf. R.A.E.*, A **6** 557], has become a serious pest of watermelons (*Colocynthis citrullus*) in Israel, where its presence has not hitherto been recorded. It has also been found on other melons and on cucumber, but not on vegetable marrow or squash. The adults feed on the leaves, stems and young fruits, but economic damage is caused only by the ovipositing females, which girdle the stem ends of the fruits, so that growth is stunted, and deposit their eggs singly in holes gnawed in the peel. The adults appear when the first fruits begin to develop, towards the end of May, and infested fruits are found early in June. In many there may be over 100 holes, and one fruit may contain more than 60–70 larvae. The eggs hatched in averages of 3·7 days at 30°C. [86°F.] and six at 22°C. [71·6°F.]. The duration of the combined egg and larval stages ranged from 12 to 29 days, and total development lasted 25–42 days in summer, when the temperature fluctuated between 24 and 29°C. [75·2 and 84·2°F.]. The larvae feed on the developing seeds inside the fruit and pupate there in cocoons constructed of small pellets consisting of dried fruit pulp mixed with a fluid, believed to be produced in the Malphigian tubules, that is squeezed from the anus. The preoviposition period lasts about four days, and the adults survive for several weeks. There are three generations a year, and four if weather conditions are favourable. The adults hibernate; survival among over-wintering adults was greatest among those that emerged latest. It is suggested that increased cultivation of cucurbits and the lengthening of the cropping period by irrigation may have permitted populations of this weevil to increase.

WILLIAMS (J. R.). **The control of black sage** (*Cordia macrostachya*) **in Mauritius: the introduction, biology and bionomics of a species of** *Eurytoma* (**Hymenoptera, Chalcidoidea**).—*Bull. ent. Res.* **51** pt. 1 pp. 123–133, 1 pl., 4 figs., 3 refs. London, 1960.

The following is almost entirely the author's summary. An account is given of the establishment and bionomics in Mauritius of a species of *Eurytoma* near *E. howardii* D.T. that was introduced from Trinidad to supplement the activity of *Schematiza cordiae* Barber in controlling the introduced noxious shrub, *Cordia macrostachya* [*cf. R.A.E.*, A **40** 5–6], together with descriptions and figures of the egg and larval stages. The entire development of *Eurytoma* takes place within the *Cordia* fruit, which contains usually only one seed when mature and has a hard, stony endocarp and a soft, fleshy mesocarp. Oviposition takes place before the endocarp hardens; the egg is laid in the seed, and the larva feeds on the nucellus and endosperm and later on the developing cotyledons, until the entire seed, except for the seed coat, has been consumed. The attacked fruit continues to grow, and its endocarp hardens, but final swelling of the mesocarp does not take place. Although more than one egg may be laid in a seed, only a small percentage of the many seeds dissected contained two mature larvae or two pupae. Pupation takes place within the seed, from which the adult escapes by boring a round hole through the endocarp. Development from egg to adult occupies about 23 days in the hot season (November–April), but in the cooler months (June–September) the fully grown larva enters a resting period, which may last several months. Adults kept in jars and provided with honey in water, at a mean temperature of 25°C. [77°F.], lived for an average of 11 days (males) or 20 days (females). A newly emerged female contains about 12 fully developed eggs. Unmated females oviposit readily, all the progeny being male.

Releases of adults from material received from Trinidad were made between October 1949 and May 1950; it was evident by the latter date that the insect had become established at the first liberation site, and further colonies were established in various parts of the island from material collected there. Estimates of infestation of samples of fruit collected in October 1951 at or near 22 liberation points ranged from 16 to 81 per cent. (with a mean of 53·7 per cent.). The latest island-wide estimates, in February, June and October 1953, showed averages of 64·6, 40·8 and 48·7 per cent. infestation, respectively.

Infestation of fruits is highest (70–80 per cent.) in the hot season, when fruit production is at its maximum, and lowest in the cooler months, when, although the rate of fruiting declines, the life-cycle of *Eurytoma* is prolonged. *Schematiza* had achieved a high degree of control of *Cordia* before *Eurytoma* became widely established, and it is difficult to assess the contribution made by the latter, which has no known specific natural enemies in Mauritius; but the two unrelated insects acting jointly are likely to stabilise control more effectively than would one insect alone.

In an appendix (pp. 132–133), P. O. Wiehe gives notes on the present ecological status of *Cordia* in Mauritius and contrasts it with that prevailing before the introduction of *Schematiza* and *Eurytoma*. He concludes that the secondary succession of vegetation has now reverted to its former course.

HOCKING (B.). **An insect-proof doorway.**—*Bull. ent. Res.* **51** pt. 1 pp. 135–144, 3 figs., 4 refs. London, 1960.

The following is based largely on the author's summary. The effects of various factors on the passage of flying and crawling insects through a doorway were investigated in the laboratory with honey bees, *Musca domestica* L., *Drosophila melanogaster* Mg., and a Chloropid. From the results, it is considered practicable to exclude flying insects from a building or to prevent their successful escape from cages or rearing rooms by means of a downward air current if the speed of this in feet per minute multiplied by the ratio of the length through the doorway to its height is not less than 550. At all natural population densities, a combination of reflex and illuminated edges, smooth shiny walls without a pattern visible to insects, and a floor grid and underlying screening treated with a long-lasting residual insecticide would reduce to an insignificant level the number of insects that crawl through and survive. Artificially higher densities, as in rearing rooms, may require the doorway to be fitted with sliding doors in addition. These may be arranged to switch on the air current and lights as soon as they are opened.

EADY (R. D.). *Pentalitomastix*, **a new name for** *Pseudolitomastix* **Eady (Hymenoptera, Chalcidoidea).**—*Bull. ent. Res.* **51** pt. 1 p. 173, 2 refs. London, 1960.

An Encyrtid parasite of *Nacoleia octasema* (Meyr.) was recently described by the author as *Pseudolitomastix nacoleiae*, gen. et sp. n. [*R.A.E.*, A **48** 167]. The name selected for the new genus proved to be preoccupied [**48** 167, note], and *Pentalitomastix* is here proposed for it.

CORNWELL (P. B.). **Movements of the vectors of virus diseases of cacao in Ghana. II. Wind movements and aerial dispersal.**—*Bull. ent. Res.* **51** pt. 1 pp. 175–201, 2 pls., 12 figs., 14 refs. London, 1960.

The following is based on the author's summary of this part of a series on the movements of mealybugs that transmit the swollen-shoot disease of cacao in Ghana [*cf. R.A.E.*, A **46** 417], in which an account is given of studies on their aerial dispersal and the possible influence on it of wind speed. Seasonal variations in wind speed in Ghana are slight, particularly inland in the cacao-growing areas. Observations at Tafo in 1955 showed that air movement was maximal between 12.30 and 3 p.m. and minimal during darkness. Daily wind speeds in the open, from April to November, averaged 1·1 miles per hour 4 ft. above ground. About 80 per cent. of wind speeds measured in one-minute periods on two days in February were within the range 1–5 m.p.h. and 11–12 per cent. between 5 and the maximum recorded speed of 7 m.p.h. In cacao, wind speeds were only 5–10 per cent. as great; daily speeds averaged 0·09 m.p.h. at 8 ft. above ground during April and May. The highest daily averages under a closed canopy (400–650 ft. per hour) were recorded 2 ft. above ground-level; speeds fell to a minimum (25–125 ft. per hour) in the canopy at 15–25 ft., and rose again above the canopy at 30 ft. to a speed (250–350 ft. per hour) comparable with that just below the branches at 10 ft. At breaks in the canopy caused by the removal of diseased trees, daily averages were lowest (125–150 ft. per hour) 2 ft. above the ground. They rose to a peak (400–600 ft.) on a level with the lower branches, dropped markedly (250–450 ft. per hour) at the level of the middle canopy and rose to a maximum (650–1,000 ft. per hour) at 30 ft.

All instars of *Planococcoides* (*Pseudococcus*) *njalensis* (Laing) walking on pieces of cacao wood in the laboratory withstood removal by winds of 10 m.p.h., but these and corresponding stages of three other species could be dislodged by gently tapping the wood. The late nymphs and adults of *P. njalensis* and *Pseudococcus gahani* Green were more easily removed than their crawlers, though this difference was not found between the developmental stages in *Planococcus citri* (Risso) and *Ferrisiana virgata* (Ckll.). Amongst the four species tested, first-instar nymphs of *P. citri* were most easily dislodged, and those of *Planococcoides njalensis* and *F. virgata* more so than those of *Pseudococcus gahani*.

Airborne mealybugs were caught on adhesive traps, on bait twigs pinned to dead trees and on cacao seedlings. Eight vector species became established on cacao after dispersal by air currents. Under a closed canopy, more airborne mealybugs were caught at 2 and 10 ft. above ground than at levels in and above the canopy. At breaks in the canopy, catches averaged about 13 per cent. of those obtained under a continuous canopy and were insufficient to show changes in aerial density with height. The distribution of catches over the surface of traps suggested that mealybugs drop from the branches, are carried by air currents when falling, and become laterally dispersed at levels a few feet above the ground. In a clearing from which cacao had been removed to simulate conditions following the routine cutting out of virus-infected trees, airborne mealybugs became established on seedlings at a distance of 45 ft. from infested cacao trees. The ratios of boxes of seedlings that became infested by aerially dispersed *Planococcoides njalensis* at increasing distances from infested standing cacao, in relation to those beneath it (unity), were 0·86 at 10–20 ft., 0·57 at 30 ft. and 0·14 at 40–100 ft. Under conditions of high insolation, the maximum recorded distance of aerial dispersal from surrounding vegetation to cacao seedlings was 340 ft. Aerial catches on seedlings 40–165 ft. from cacao showed an over-all decrease with distance. Aerial dispersal is more pronounced during dry conditions, particularly during the main dry season (December–February), and to a lesser extent during the brief dry period experienced in July or August. The infestation rate of cacao seedlings by windborne mealybugs (predominantly *Planococcus citri* and *F. virgata*) was increased by 50 per cent. when plants were protected from the weather by artificial shade. These traps, insulated from ants, failed to become infested by *Planococcoides njalensis*.

Out of 64 young cacao trees, 22 per cent. became infested by airborne vectors during May–September 1955; when, on similar trees, normal dispersal was augmented by an initial artificial colonisation with *P. njalensis*, the corresponding percentage was 41. The infestation rate, after either augmented or natural dispersal, was not significantly affected by attempts to establish nests of the ant, *Crematogaster striatula* Emery, on the trees or by affording protection from the weather in the form of artificial shade. It was evident, however, that the presence of mealybug-attending ants is almost essential for infestations of *P. njalensis* to develop, but there must be other limiting factors, since establishment failed on 58 per cent. of trees on which coccidophilic species were present.

The part played by airborne vectors in extending infection by radial and 'jump spread' is discussed, together with the possible use of insecticides to prevent their establishment on the trunks of healthy cacao.

Cranham (J. E.). **Insect infestation of stored raw cacao in Ghana.**—*Bull. ent. Res.* **51** pt. 1 pp. 203–222, 4 graphs, 6 refs. London, 1960.

The following is virtually the author's summary. In Ghana, a considerable part of the main-crop cacao is stored for six months or more, and some for up to nine months; infestation by insects increases during storage, and data, obtained chiefly in Ashanti from the 1957–58 main crop, are given. Assessment by sieving the contents of whole bags and counting the numbers of adults (and, in the case of *Ephestia cautella* (Wlk.), of the larvae and pupae) showed that at the beginning of the main-crop season (September–November), infestation was very light (1–2 insects per bag), but was present in a high proportion of the bags (46–47 per cent. in October). The species present represented those found regularly breeding in cacao in Ghana, namely, *E. cautella*, *Lasioderma serricorne* (F.), *Araecerus fasciculatus* (Deg.), *Tribolium castaneum* (Hbst.), *Carpophilus dimidiatus* (F.), *Ahasverus advena* (Waltl), *Cryptolestes* spp., and an unidentified Cucujid (Silvanid). After storage for six months, the total count averaged over 100 per bag and comprised chiefly *L. serricorne* and *T. castaneum*; larvae of *Ephestia* were much rarer (less than five per bag), but adults of *Ephestia* were abundant in the sheds after storage for 2–3 months. Sieving proved a useful technique for obtaining data on infestation, though careful supervision of staff was necessary to minimise errors. Variation from bag to bag in the same lot of cacao was large, and estimates based on as few as four bags were unreliable.

Assessment of insect damage from samples of cacao beans taken fortnightly by spear-sampling showed an increase from 0·2 per cent. insect-damaged beans in November to 1–1·9 per cent. in June. Of 21,000 beans examined in April and May, *L. serricorne* occurred in 0·17 per cent., and 0·6 per cent. contained living insects. Damage by insects affecting more than 2 per cent. of the beans has been uncommon in Ghana in the past few years. The effect on quality, as assessed by commercial grading and considered financially, is at present slight, as it also is in terms of loss of weight over the whole crop (certainly less than 0·1 per cent.). *E. cautella* is the most important species economically, because it can infest the premises of cocoa and chocolate manufacturers in importing countries and spread to finished confectionery. It affects a large portion of the crop in significant numbers.

The primary infestation of cacao before it comes into licensed storage occurs in small farms and villages, and no one district or type of source is of special importance. Increase of the infestation during storage occurs chiefly as a development of this primary infestation; cross-infestation from outside sources is relatively unimportant.

The application of synergised pyrethrins in white oil within storage sheds as a fog, from which a film was deposited on the stacked bags of cacao, was carried out in many sheds at intervals of 3–4 days, and a comparison was made between sprayed and unsprayed sheds, based on data from sieving. Spraying did not substantially reduce the development of infestations of *L. serricorne* or other beetles, nor was *E. cautella* controlled to a degree comparable with experience of similar treatment against *E. clutella* (Hb.) in Britain; this may be due to the fact that *E. cautella* in Ghana develops in bags throughout the stack, and not chiefly in the peripheral bags, as does *E. clutella* in Britain. Conditions affecting the film-spraying of bagged cacao in Ghana differ greatly from those in Britain. Uncontrolled ventilation at the eaves of sheds results in a considerable loss of insecticide fog and in uneven distribution of deposit; the undersurface of the stacks cannot be sprayed, because they rest on wooden dunnage; it is difficult to maintain an effective oil-film on the topmost horizontal surfaces of the stack, near the roof, of which the temperature frequently exceeds 100°F.; and deposits probably do not retain their toxicity for more than a few days. Variations in the materials from which cacao-storage sheds are constructed, and in their design, cause relatively small differences in internal climatic conditions, and these have even less effect on the temperature of the cacao in bags, which is generally in the range 82–88°F. The moisture content of the cacao was about 1 per cent. less in a hotter than in a cooler type of shed, and it is considered that the construction of sheds should aim at producing the hotter, drier conditions that are attainable, in order to keep moisture contents down and restrict the development of moulds, mould-feeding beetles and *Araecerus fasciculatus*.

Cancela da Fonseca (J. P.). **Aspectos fitossanitários do amendoim (mancarra) armazenado, na Guiné Portuguesa. II. Montes e benténs no campo. III. Armazéns de entidades comerciais.** [Phytosanitary aspects of groundnuts stored in Portuguese Guinea. II. Mounds and containers in the field. III. Stores on commercial premises.]—*Garcia de Orta* **6** no. 4 pp. 605–621, 13 refs. Lisbon, 1958. (With summaries in French & English.)

In these two parts of a series [*cf. R.A.E.*, A **47** 416], lists are given of the insects found infesting stored groundnuts in heaps and elevated containers in the field and in groundnuts stored on commercial premises, respectively, in Portuguese Guinea during inspections in 1954, and their importance is discussed.

The principal pests found in small heaps, in which the harvested groundnuts are left to dry, were *Dieuches armipes* (F.) and *D. patruelis* (Stål); the other Lygaeids, *Aphanus sordidus* (F.) and *A. apicalis* (Dall.), were uncommon, as also were *Caryedon gonagra* (F.) and other beetles. The Lygaeids continued to be numerous or increased after the small heaps had been united into mounds, but *C. gonagra* and the other insects remained relatively unimportant. The Lygaeids were also numerous and *C. gonagra* relatively uncommon in elevated containers. It is concluded that drying in the field should be curtailed so far as possible, and the groundnuts separated from the plant immediately after harvest and stored in suitable vessels in buildings.

C. gonagra was the main pest in commercial storehouses, together with *Tribolium castaneum* (Hbst.) and sometimes *Oryzaephilus mercator* (Fauv.) and *T. confusum* Duv.; other species were also present. *C. gonagra* was not found in empty warehouses during the rainy season, although it bred in stored groundnuts at that time.

Amaro (J. P.), Ferrinho (H.) & Cancela da Fonseca (J. P.). **Contribuição para o estudo da dinâmica das populações de** *Caryedon gonagra* **(F.).** [Contribution to the study of the population dynamics of *C. gonagra.*]—*Garcia de Orta* **6** no. 4 pp. 637–647. Lisbon, 1958. (With summaries in French & English.)

Caryedon gonagra (F.) is the principal pest of stored groundnuts in Portuguese Guinea [*cf.* preceding abstract, etc.], and investigations were carried out in the laboratory on its population increase at 30°C. [86°F.] and 55–75 per cent. relative humidity and at 40°C. [104°F.] and 65–85 per cent. relative humidity. The following is taken from the authors' summary of the results concerning the adults and eggs. At 30 and (in brackets) 40°C., the life expectancy of the adult population averaged 14·22 (9·63) days, the duration of female fertility 4·06 (2·61) days, the number of eggs laid per female 44·52 (24·16), the oviposition period 17·4 (9·5) days, the period to 50 per cent. oviposition 2·5–3·5 (1–2) days, the viability of the eggs 35·22 (19·59) per cent., and the egg stage 6 (4) days. At 30°C. there were more, and at 40°C. fewer, males than females.

Soares de Gouveia (A. J.). **Primeiros resultados de ensaios com pós insecticidas no combate a** *Zabrotes subfasciatus* **(Boh.).** [Preliminary results of tests with insecticide dusts for the control of *Z. subfasciatus.*]—*Garcia de Orta* **6** no. 4 pp. 623–636, 3 figs., 16 refs. Lisbon, 1958. (With summaries in French & English.)

Beans stored in Angola become heavily infested by *Callosobruchus maculatus* (F.), *Acanthoscelides obtectus* (Say) and *Zabrotes* (*Spermophagus*) *subfasciatus* (Boh.) [*cf. R.A.E.*, A **45** 131], and the value of various dusts for control of the last was investigated in the laboratory. The results of those with γ BHC (as lindane), which are here described, showed that complete mortality of young adults was given in 6–9 days by treating the beans with 0·5–2 parts γ BHC per million in 0·025 or 0·05 per cent. mixture with bentonite. The stronger dust also gave good results at lower rates (0·25 and 0·125 p.p.m.). Bentonite alone gave 69–99 per cent. kill, and mortality was 18 per cent. in nine days for no treatment.

Davies (J. C.). **A note on the control of bean pests in Uganda.**—*E. Afr agric. J.* **24** no. 3 pp. 174–178, 5 refs. Nairobi, 1959.

A recent survey of African farms and Indian stores in northern Uganda showed that infestation of stored pulses by Bruchids was often very heavy. Kidney beans are particularly attacked by *Acanthoscelides obtectus* (Say), the eggs of which are deposited on green pods, through cracks in drying pods or loose among beans or pods in store. The larvae hatch in about five days, bore into the beans after a short period of wandering, and feed and pupate in them. The larval and pupal stages last 2–3 weeks and 5–6 days, respectively, the adults, which do not feed, live for about two weeks, and there are 6–12 generations a year. *Callosobruchus chinensis* (L.) and *C. maculatus* (F.) are common in cowpeas, green gram [*Phaseolus aureus*] and pigeon peas [*Cajanus cajan*]; the eggs are attached to the pods or seeds, and the newly hatched larvae bore straight into these without preliminary wandering. Complete development lasts about three weeks, and the adults live for about one week and do not feed. The females of all three species lay about 200 eggs each and fly actively [*cf. R.A.E.*, A

46 213]. Infestation can begin in the field, but becomes severe only in storage premises.

In tests on the control of *A. obtectus*, freshly harvested, lightly infested beans were dried in the sun, threshed, mixed with 8 oz. 0·04 per cent. γ BHC dust per 200 lb. [*cf.* **44** 3–4] and stored in closed iron drums. Examination of treated and untreated beans at monthly intervals showed that other insects caused negligible damage. Untreated beans rapidly became heavily infested by the Bruchid, particularly at the top of the bin, whereas there was very little damage in treated beans and no difference between levels. Untreated beans were apparently reduced in weight by 4·3–4·9 per cent. in six months, but the true loss in weight was certainly greater than this. Although no exact information is available on weight loss in the smaller seeds, it is at least as great as that in beans.

It is recommended that all beans that are to be stored in Uganda for more than three months should be dusted with γ BHC as soon as possible, preferably by shaking the requisite amount of dust over a pile of beans and mixing it in with shovels, after which the beans can be returned to their bags.

Barnes (H. F.). **Experimental inter-breeding of hessian fly from Kansas, U.S.A., Germany and England.**—*Z. PflKrankh.* **65** pt. 6 pp. 333–343, 2 graphs, 6 refs. Stuttgart, 1958.

In order to provide further evidence that *Mayetiola secalis* Bollow, which was described from Bavaria, is identical with *M. destructor* (Say) [*cf. R.A.E.*, A **44** 194; **47** 277, 362], cross-breeding experiments with insects of European and American origin were carried out in England in 1957. The experiments were performed in muslin cages, each containing wheat seedlings about 6–8 in. high in pots, into which unmated females and newly emerged males or one or more recently fertilised females were introduced; the cages were kept in a glasshouse with permanently open windows screened with muslin and protected from excessive heat in summer. In 43 experiments, for which the data are given in tables, males and females from Kansas, northern Germany [**47** 277] and England interbred successfully up to and including the fourth generation, and first crosses, back-crosses and crosses between the resultant progeny all gave rise to fertile offspring. From these results and the range of variation in morphological characters shown by the midges, it is concluded that there is no specific difference between American and European populations, all being referable to *M. destructor*.

In 14 experiments in which only one female was used per cage, all or virtually all the offspring were female in eight and male in five; equal numbers of the two sexes were produced in the remaining one; sex was evidently not determined by the male parent. The number of progeny per female, reckoned for the females that gave rise to progeny of one sex only, so that the production of a second filial generation was excluded, varied from 84 to 111 males and from 5 to 189 females; numbers below about 40 were produced by females that had not recently emerged or were caged on older wheat plants. In all the experiments in which adult emergence was complete in 1957, the average number of progeny per female was 72. The females began to oviposit 2–3 hours after they had been introduced into the cages and continued throughout the day, except when the temperature reached 90–100°F.; during cooler weather, they occasionally oviposited also on the following day or the one after it. The period between the beginning of oviposition and the appearance of the first adult was shortest (31–38 days) in late July and August; it was 34–49 days between late April and mid-June and 37–60 days in September and October. Adult emergence of a given generation continued over a considerable period, but was interrupted by diapause in the autumn.

MÜLLER (F. P.). **Wirtswahlversuche mit Gynoparen von** *Myzus persicae* **(Sulz.) und von** *Aphis fabae* **Scop.** [Food-plant selection experiments with gynoparae of *M. persicae* and *A. fabae*.]—*Z. PflKrankh.* **65** pt. 7 pp. 405–411, 4 refs. Stuttgart, 1958. (With a summary in English.)

Fundatrices of *Myzus persicae* (Sulz.) complete their development on *Prunus persica* (peach), *P. nana*, *P. serotina*, *P. nigra*, some forms of *P. serrulata*, and *Lycium halimifolium*, and those of *Aphis fabae* Scop. on *Euonymus europaeus*, *Viburnum opulus* and *Philadelphus coronarius* [*cf. R.A.E.*, A **47** 347–349, etc.]. The plants suitable for the holocyclic overwintering of each of these species thus belong to different families, and investigations were carried out in Germany to ascertain whether the gynoparae, which are responsible for autumn infestation of the winter food-plants, show any preferences between them.

In the tests with *M. persicae*, gynoparae of four strains differing in origin were used. Twigs of peach, *P. nana*, *P. serotina* and apricot (*P. armeniaca*) and potted plants of *L. halimifolium* and *P. nigra* were caged, the gynoparae were evenly distributed over them at intervals, as they developed in the cultures, and the distribution of the latter on the plants and the numbers of young produced were noted 5–6 days later. The results showed that peach was preferred, irrespective of whether the strains originated from peach or *P. serotina*. *P. nana* and *P. serotina* were almost as heavily infested as peach, but other observations indicated that the last is less satisfactory as an autumn food-plant than is peach. *P. nigra* was distinctly less infested than any of these, but it is the most important winter food-plant of *M. persicae* in the northern United States, and in other tests fundatrices developed normally on it and caused rolling of the leaves as described by American authors. Apricot and *L. halimifolium* were little infested. It is not certain whether fundatrices can develop on apricot; in tests, they failed to do so, whereas development was completed on *L. halimifolium*. Gynoparae of *M. persicae* subsp. *dyslycialis* F. P. Müll. [**47** 348], which overwinters in the egg on *L. halimifolium*, causing the formation of galls, were not available for test.

In the tests with *A. fabae*, two strains were used, one from *Euonymus europaeus* and one from *Viburnum opulus*; fundatrices of the first failed to complete their development on *Viburnum* or *Philadelphus coronarius*, whereas those of the other developed on all these plants. The gynoparae were distributed over *Euonymus*, *Viburnum* and *Philadelphus*, as before, and it was found that *Euonymus* was preferred by both strains. The first infested the other two plants very lightly, but the second favoured *Viburnum* nearly as much as it did *Euonymus*.

GÜNTHER (S.). **Eine bisher unbekannte Mikrosporidie aus dem Ringelspinner** (*Malacosoma neustria* **L.; Lasiocampidae).** [A hitherto unknown species of Microsporidia from *M. neustria*.]—*Z. PflKrankh.* **65** pt. 9 pp. 534–535, 7 refs. Stuttgart, 1958. (With a summary in English.)

An outbreak of *Malacosoma neustria* (L.) occurred on apple trees near Bautzen, eastern Germany, in 1955 and 1956. In the second year, 95 per cent. of the larvae taken to the laboratory died within a fortnight. Most of the mortality was due to polyhedral virus disease and bacteria, but 21 per cent. of the larvae were infected by Microsporidia. These are described as *Plistophora neustriae*, sp.n. In tests, *P. neustriae* proved pathogenic to *Lymantria dispar* (L.) and *Hyponomeuta padellus malinellus* Zell., but not to the brown-tail moth, *Euproctis chrysorrhoea* (L.).

DOMES (R.). **Zur Biologie der Gallmilbe** *Eriophyes gracilis* **Nalepa.** [On the bionomics of *Phyllocoptes gracilis*.]—*Z. angew. Ent.* **41** (1957) pt. 4 pp. 411–424, 7 figs., 22 refs. Hamburg [1958]. (With a summary in English.)

Phyllocoptes (*Eriophyes*) *gracilis* (Nal.), which causes injuries to raspberry that can be confused with those caused by certain virus diseases [*cf. R.A.E.*, A **40** 279], is widespread in western Germany. The distribution of the mite is briefly reviewed, the morphology and anatomy of the adults are described and compared with those of the nymphs, and an account is given of the embryonic development of the egg. Investigations showed that the adults overwintered in the axillary buds. They resumed activity in spring when the buds were opening and temperatures exceeded 11°C. [51·8°F.], and, at temperatures of about 25°C. [77°F.], oviposition occurred as early as seven days after they had left their winter quarters, eggs being laid on the lower surfaces of the leaves and on the leaf and flower stalks. At 25°C., the egg and nymphal stages each lasted a week. In 1955, all stages of the mite were present from 25th April, and numbers increased, accompanied by the gradual spread of infestation to the new canes (to which the mites were probably largely carried by the wind) until August, when up to 120 individuals per sq. cm. of leaf occurred on one fairly susceptible variety. The mites ceased feeding by the end of November, but a few failed to enter the buds to overwinter; most of these died in the winter of 1955–56, when very cold weather occurred in February. In addition to discoloration [*cf. loc. cit.*], heavy infestation caused swellings on the leaves, but varieties with an average of less than six mites per sq. cm. of leaf showed no symptoms. Root cuttings taken from infested plants and kept free of infestation developed normally, thus confirming that a virus was not involved. Heavy infestation resulted in a weakening of the plants and loss of yield. In control tests, a spray of 3 per cent. heavy oil emulsion or 0·75 per cent. dinoseb applied in February 1955 was ineffective, but repeated spraying with parathion (E605) or demeton (Systox) in the summers of 1954 and 1955 gave good results. An unidentified predacious mite, of which 3–4 individuals destroyed a large population of *P. gracilis* in greenhouse tests, occasionally afforded considerable control; the eggs required 4–5 days for hatching when daily temperatures reached 20°C. [68°F.].

P. gracilis was the only injurious mite found on raspberry; notes are given on the characters of two unidentified Eriophyids observed on wild blackberry in February 1956.

TEMPLIN (E.). **Der Einfluss von Bekämpfungsaktionen auf den Verlauf der letzten Gradation von** *Euproctis chrysorrhoea* **L.** [The influence of control measures on the course of the last outbreak of *E. chrysorrhoea*.] —*Z. angew. Ent.* **41** (1957) pt. 4 pp. 425–437, 3 maps, 34 refs. Hamburg [1958]. (With a summary in English.)

An outbreak of *Euproctis chrysorrhoea* (L.) began in Europe about 1948–50, extending in a broad band across many countries, and large-scale control measures became necessary in some places. In eastern Germany, it reached a peak in 1953, when about 37,000 acres of forest and orchard and 7,000 miles of vegetation along roads or in similar positions were attacked, and then declined. Tachinids and fungi were the main causes of the decline in the northern and central parts of the country. In the valleys of the Saale and Elbe, where infestation was particularly heavy, parasitism was generally lower than 10 per cent. in 1952, but then increased rapidly. In one locality, 64·5 per cent. of the larvae and pupae were parasitised by Diptera and 9·5 per cent. by Hymenoptera in 1955, and, in other localities, up to 60·5 and 43·8 per cent. of the larvae were parasitised by *Monodontomerus aereus* Wlk. and *Eupteromalus nidulans* (Först.), respectively, in the winter of 1955–56. In a further locality, 97 per cent. of the pupae were reported to be infested by a fungus of the genus *Scopulariopsis* on 20th July 1956. Microsporidia of the species *Plistophora schubergi* and, to a less extent, a polyhedral virus were important in the south of the region, where up to 70–80 (and even 95) per cent. of the population became infected. The outbreak was terminated in 1955–56.

To prevent infestation spreading to fruit trees, dusts or aerosols of DDT or DDT and BHC were applied in 1952–56, mainly near the edges of forest stands and in places adjoining orchards or habitations, the latter because of the irritation caused by the hairs of the larvae. About half of all infested stands were treated in 1953 and more in 1954, and it was necessary to treat many in several consecutive years. Assessment of the results was made in some localities in the Saale-Elbe area, where treatment was carried out mainly in May–June, and this showed that although 70–95 per cent. mortality of the larvae was obtained and defoliation during the year of treatment was prevented, fruit trees were nevertheless infested and heavy infestation recurred in many places the year after treatment. In some treated forests, infestation persisted for longer than in neighbouring untreated or less intensively treated areas. Parasitism increased less in treated than in untreated stands unless treatment was carried out in March–April.

VIETINGHOFF-RIESCH (A. Frhr. von). **Untersuchungen über Verbreitung und Schadwirkung des Lärchenblasenfusses** (*Taeniothrips laricivorus* **Krat.) in den Randzonen seines Verbreitungsgebietes in Norddeutschland, der Schweiz und Frankreich.** [Investigations on the distribution and injuriousness of *T. laricivorus* in the peripheral regions of its distribution in northern Germany, Switzerland and France.]—*Z. angew. Ent.* **41** (1957) pt. 4 pp. 449–474, 12 figs., 5 refs. Hamburg [1958]. (With a summary in English.)

Investigations were carried out in 1954–55 on the factors limiting the distribution of *Taeniothrips laricivorus* Krat. & Farský on larch in north-western Germany, Switzerland and eastern France, near the western edge of the region infested by this thrips. The literature on its occurrence in Europe [*cf. R.A.E.*, A **48** 87, etc.] is summarised, and the results of the investigations are reviewed in detail, by districts. In Germany, cultivation of larch in groups, particularly under a canopy, sporadic occurrence or low age of trees and mixed planting tended together, but not as individual factors, to minimise infestation, but the cultivation of large areas of mixed forest with a high proportion of larch, the presence of long top-shoots and planting of the trees together with spruce, on which the thrips overwinter, all favoured it. In Switzerland and Lichtenstein, the felling of large, canopy trees favoured attack but mixed forest with a low proportion of larch was unfavourable to it; few trees situated above about 3,200 ft., except those of unsuitable origin artificially planted in avalanche paths, were infested. Similar results were obtained in France, where infestation was found to extend further south and west than was formerly known and reached many parts of the Massif Central, as far as the departments of Corrèze and Cantal. The present and former known limits in this part of Europe are shown on a map.

KLOFT (W.). **Untersuchungen an der Rinde von Weisstannen** (*Abies pectinata*) **bei Befall durch** *Dreyfusia* (*Adelges*) *piceae* **Ratz. Vorläufige Mitteilung.** [Investigations on the bark of *A. alba* infested by *Chermes piceae*. Preliminary report.]—*Z. angew. Ent.* **37** pt. 3 pp. 340–348, 4 figs., 14 refs. Berlin, 1955. (With a summary in English.) **Further investigations concerning the interrelationship between bark condition of** *Abies alba* **and infestation by** *Adelges piceae typica* **and** *A. nüsslini schneideri*.—*Op. cit.* **41** (1957) pt. 4 pp. 438–442, 12 refs. Hamburg [1958]. (With a summary in German.)

In the first paper, an account is given of investigations near Zürich in 1954 on the effect on bark of silver fir (*Abies alba* (*pectinata*)) of infestation by *Chermes* (*Dreyfusia*) *piceae* Ratz. The staining processes employed are specified, and the following is based on the author's summary of the results. The aphids feed on the phellogen, phelloderm and parenchyma and on the epithelium of resin channels. The stylets of the insect penetrate intercellularly and the cells lose their polysaccharide and protein granules, the cytoplasm becomes more compact, and the nuclei become pycnotic. Mass infestation for 2–3 years destroys all the outer parenchyma, and death of the phellogen causes a pathological condition of the bark, so that the aphids are ultimately deprived of food. Reinfestation can occur after about ten years, when the bark has been regenerated. The reaction of *A. alba* to *C. piceae* thus differs from that of balsam fir (*A. balsamea*) in Canada [*cf. R.A.E.*, A **42** 263], since there is no tendency for the bark to swell and food is not available for the aphids for so long a time.

The second paper contains the results of further investigations carried out in 1955 with bark infested by *C. piceae* form *typica* and *C. nordmannianae* Eckstein (*D. nüsslini* Börn.) form *schneideri* (Börn.) [*cf.* **46** 246], which caused similar symptoms. The aphid population varied directly with the amount of active protein in the bark. The respiration rate of the bark and the activity of acid phosphatases in it increased in proportion to the population, evidently being stimulated by the saliva of the aphids, and the resulting increase in soluble nitrogenous constituents counteracted bark degeneration for a time, allowing the population to continue to increase. This stage was later followed by degeneration.

EICHHORN (O.). **Eine neue Tannenlaus der Gattung** *Dreyfusia* (*Dreyfusia merkeri* **nov. spec.**). [A new fir aphid of the genus *Chermes* (*Dreyfusia*) (*C. merkeri*, sp.n.).]—*Z. angew. Zool.* **44** pt. 3 pp. 303–348, 13 figs., 17 refs. Berlin, 1957. (With a summary in English.)

The author reviews the species of *Chermes* (*Dreyfusia*) that infest fir (*Abies*) in central Europe and the forms into which they have provisionally been divided [*R.A.E.*, A **46** 246] and states that they can best be differentiated by the numbers of pores on the middle field of the spinal plates of the meso- and metathorax and first three abdominal tergites of young nymphs of the sistens type; the differences are described and figured. The name *C.* (*D.*) *merkeri*, sp.n., is proposed for the form previously termed *C.* (*D.*) *piceae* Ratz. form *aggressiva* [*loc. cit.*], which was found on silver fir (*A. alba*) near Freiburg, in the Black Forest, in the autumn of 1953, and since the form of *C. piceae* that occurs on balsam fir [*A. balsamea*] in Canada differs substantially from the European *C. piceae* form *typica*, its closest ally, the name *C.* (*D.*) *piceae* form *canadensis* is used for it. The other European forms are *C. nordmannianae* Eckstein (*D. nüsslini* Börn.) forms *typica* and *schneideri* (Börn.), which are difficult to distinguish from each other, and *C.* (*D.*) *prelli* (Grossman). Characters are given distinguishing the young nymphs and adults of the various generations of *C. merkeri* on fir and spruce from those of *C. nordmannianae* and *C. prelli*, which both infest *A. alba* and *A. nordmanniana*, and the bionomics of *C. merkeri* are compared with those of the other two from observations at Freiburg. All three migrate to *Picea orientalis* (their primary food-plant), and the galls formed on this are compared.

Infestation by *C. merkeri* was considerable at Freiburg, where *A. nordmanniana* was also attacked, and the species apparently occurred as far away as Oldenburg (since *A. nordmanniana* brought from there was found to be infested at the beginning of November 1954). It occurred on *A. alba* of all ages and on *A. nordmanniana* up to ten years of age, but development was somewhat slower on *A. nordmanniana* than on *A. alba*. It was also reared on *A. balsamea* and *A. grandis*. The sistentes fed on the bark and sometimes on the buds, and, on young trees, under bud scales at the junction of shoot and twig. The sexuparae and progredientes, like those of *C. nordmannianae* [*cf.* **25** 727], infested the May needles. *C. prelli* occurred mainly on *A. nordmanniana*, and, although the trunks were attacked, injury was most severe in the tops of the crowns [*cf.* **26** 3]. The sequence of generations was similar for *C. merkeri* and *C. prelli* and differed from that of *C. nordmannianae* only in that the two former produced a second generation of aestivosistentes. Observations on seasonal occurrence are recorded in detail.

Of the various stages of *C. merkeri*, nymphs of the sistens type did the most damage, especially those at the junction between shoots. Losses of very young trees (*A. alba*) were heavy, since they could be destroyed by one or two hiemosistentes and their progeny. In one nursery, 25 per cent. of the May shoots in a bed of trees two years old that had become infested in 1953 were destroyed by the spring of 1954, and 87–95 per cent. of trees 3–4 years old in other beds were infested. Damage to trees 10–30 years old was somewhat less severe than that caused by *C. nordmannianae*, the May shoots usually being destroyed only during the course of two or more vegetative periods.

Gäbler (H.). **Beiträge zur Kenntnis der Schadinsekten der Blüten und Samen von Forstgehölzen.** [Contributions to knowledge on insect pests of the flowers and seeds of woody forest plants.]—*Arch. Forstw.* **7** pt. 10–11 pp. 786–827, 61 figs., 72 refs. Berlin, 1958. (With summaries in Russian & English.)

The author investigated the insects that damage the flowers or seeds of forest trees and shrubs in Germany in 1954–57 and here presents the results, arranged under the plants concerned. Special attention is paid to the less well-known species, and the work contains numerous descriptions and figures of larvae, pupae and the types of damage caused.

Evenhuis (H. H.). **Een oecologisch onderzoek over de appelbloedluis,** *Eriosoma lanigerum* **(Hausm.), en haar parasiet** *Aphelinus mali* **(Hald.) in Nederland.** [An ecological investigation on *E. lanigerum* and its parasite, *A. mali*, in Holland.]—*Tijdschr. PlZiekt.* **64** pt. 1 pp. 1–103, 2 pls., 11 graphs, 3½ pp. refs. Wageningen, 1958. (With a summary in English, pp. 87–99.)

The following is based on the author's summary. *Aphelinus mali* (Hald.) was introduced into Holland against *Eriosoma lanigerum* (Hsm.) on apple in 1924 [*R.A.E.*, A **13** 362] and became established, but the aphid remained an important pest [*cf.* **16** 341, 689]. Investigations on the reason for this are described.

In Holland, only the apterous parthenogenetic viviparae of *E. lanigerum* are responsible for population increase; they hibernate mostly as young nymphs, usually in the first instar, and become active in the latter part of March. Alate virginoparae, which occur in June–July, are rare, and though sexual forms appear in autumn and winter eggs are laid, the fundatrices hatching from them invariably die [*cf.* **20** 3]. The roots of apple trees are occasionally infested, but only when they are exposed by cultivation, and observations showed no tendency to migrate from trunks or branches to the roots. Mortality is high in cold weather.

In investigations at constant temperature, the rate of development was very variable, lasting 8–11 days at 26°C. [78·8°F.], 11–17 days at 20·5°C. [68·9°F.] and 16–27 days at 17°C. [62·6°F.]. The variation occurred mostly in the first instar, which lasted the longest, and was due to wandering before the young nymphs became established; 11–12 generations a year were produced in the field. The number of progeny per female ranged up to about 200 and did not vary significantly with temperature. The reproductive period was about 1·5–2 times as long as the developmental period, and production of nymphs increased until half-way through it and then decreased.

A. mali hibernates as a full-grown larva in diapause in the mummified host, the adult emerging in spring. Complete development lasted 12·5 days at 30°C. [86°F.], 14·5 days at 25°C. [77°F.], 22·5 days at 20°C. [68°F.] and 44 days at 15°C. [59°F.]. Details of the egg, larval and pupal stages are given; their durations were in the ratio of about 1:4:5. There were normally five generations a year in the field, and sometimes a partial sixth. The number of eggs laid per female averaged about 85 and ranged up to 177. About 11 were laid per day for some 8 days. Unfertilised females gave rise to males only, and fertilised ones to both sexes. Females were about as numerous as males in the hibernating population, but more numerous in the summer generations. The capacity of the parasite for increase at 18°C. [64·4°F.] was much less than that of its host. Observations on the phenology of the two are recorded; the aphid resumed development in the second half of March, and the first adult parasites usually emerged during May, the date varying considerably from year to year.

Other observations showed that *A. mali* had no other host, though eggs were sometimes laid in *E. lanuginosum* (Htg.) on pear, that superparasitism occurred at high parasite densities, that all stages of *E. lanigerum* were attacked, that the females sometimes punctured aphids and fed on their body fluids but caused little or no mortality in this way, and that parasitism rarely occurred in the dark. Three species of hyperparasites were reared from *E. lanigerum*, but were of little importance; they were *Pachyneuron aphidis* (Bch.), *Asaphes vulgaris* Wlk. and *Ceraphron* sp.

The aphid was also attacked by several predacious insects, notes on which are included, but they were seldom of importance in commercial orchards. The aphid population sank to a low level in winter but increased rapidly in spring and summer, reaching a peak in August, after which it declined until the end of September, when there was a further increase, followed by another fall. The decrease in August–September was not due to parasites or predators, since it also occurred when the aphids were protected by cages, and low relative humidity combined with high temperature was also not responsible for it. It may be related to some physiological condition of the trees, and was also observed on potted seedlings in the laboratory.

Parasitism reached a peak early in the season, but was never 100 per cent., owing to inability of the parasite to find all the potential hosts. It then decreased, but increased again by midsummer and then continued at a high level while the host population was decreasing, falling again in autumn. The failure of the parasite to control the aphid is attributed to its lower capacity for increase and its failure to effect 100 per cent. parasitism in spring.

Meltzer (J.) & Dietvorst (F. C.). **Action of Tedion on eggs and ovaries of spidermites.**—*Tijdschr. PlZiekt.* **64** pt. 1 pp. 104–110, 1 fig., 7 refs. Wageningen, 1958. (With a summary in Dutch.)

Tedion is known to affect the eggs and the ovaries of the ovipositing females of Tetranychids [*R.A.E.*, A **48** 90, etc.]. In tests, details of which are given, it was equally effective against eggs of *Tetranychus telarius* (L.) (*urticae* Koch) dipped in various concentrations when they were 0–4 days old. If hatching occurred, death usually ensued by the nymphochrysalis stage. When females were confined for three days on plants treated with Tedion and then transferred to untreated ones, no viable eggs were laid for five days [*cf.* **47** 319], after which the number increased until it reached the normal level after a further three days. The effect was the same when the mites were confined on the lower surfaces of leaves treated on the upper surfaces only. With *Panonychus* (*Metatetranychus*) *ulmi* (Koch), the ovaries were also affected, but for a shorter period. Chlorbenside and fenson (CPBS), especially the former, had similar effects.

Lekander (B.). **Der doppeläugige Fichtenbastkäfer** *Polygraphus poligraphus* **L. Ein Beitrag zur Kenntnis seiner Morphologie, Anatomie, Biologie und Bekämpfung.** [*P. poligraphus.* A contribution to knowledge of its morphology, anatomy, bionomics and control.]—*Medd. SkogsforsknInst.* **48** no. 9, 127 pp., 70 figs., 3 pp. refs. Stockholm, 1959. (With a summary in Swedish.)

The following is based on the author's summary. Spruce suffering from drought in Sweden, particularly in the east of the country, was heavily attacked by *Polygraphus poligraphus* (L.) in 1955–57. All stages of this bark-beetle and its internal anatomy are described in detail, and an account is given of observations on its bionomics. These showed that it breeds in standing spruce trees and occasionally in pines. Trees of all trunk diameters greater than 2 cm. are attacked, especially those severely weakened, irrespective of position in the open or in a closed stand. Adults emerge mainly at the end of July or the beginning of August, but may do so considerably earlier or later, according to conditions. Flight occurs in the afternoon and evening, and the beetles are able to fly for at least a kilometre in search of suitable trees. Entry into a tree is effected by the males, and galleries for pairing and oviposition are constructed by the females, which deposit 10–15 eggs each. The larvae overwinter, as also do late females that have not completed oviposition by the onset of cold weather. The latter continue egg-laying in spring, and larvae from spring-laid eggs mature at the same time as overwintered larvae. There is only one generation a year. Females are in general more numerous than males. Parasitism was very variable and of less importance for control than attack by woodpeckers. Winter mortality reached 80–90 per cent. Control measures appear necessary only in exceptional cases. Tests in which standing trees were used as traps were made, but the results were not very satisfactory. Fallen trees are not attacked.

MUSIL (M.) & VALENTA (V.). **Prenos stolburu a príbuzných vírusov pomocou niektorých cikád (predbežná zpráva).** [Transmission of the stolbur and related viruses by some leafhoppers (preliminary report).]—*Biológia* **13** pt. 2 pp. 133–136, 12 refs. Bratislava, 1958. (With summaries in Russian, German & English.)

In experiments in Czechoslovakia, the stolbur virus was transmitted by *Aphrodes bicinctus* (Schr.), *Macrosteles laevis* (Ribaut) and *Euscelis plebeja* (Fall.) to white clover (*Trifolium repens*), alsike clover (*T. hybridum*) and China aster (*Callistephus chinensis*) [*cf. R.A.E.*, A **48** 100]. A related virus causing phyllody in clover was transmitted to the same plants and *Vinca rosea* by *A. bicinctus* and probably also by the other two Cicadellids.

NIKOLOVA (V.). **A study of** *Suillia* (*Helomyza*) *lurida* **Meig. (Dipt.)—a hitherto unknown plant pest.** [*In Bulgarian.*]—*Bull. Inst. zool. Acad. Sci. Bulg.* **8** pp. 205–234, 24 figs., 8 refs. Sofia, 1959. (With summaries in Russian & English.)

Suillia lurida (Mg.) is recorded as a new pest of garlic sown in autumn in Bulgaria; autumn-sown onions and overwintered leeks are also attacked. All stages of this Helomyzid are described, and an account is given of observations on its bionomics and the damage caused. There is only one generation a year; the adults overwinter in diapause and are active in February–April, when eggs are laid on the stems at soil level. The egg, larval and pupal stages last about 15, 28–35 and 32 days, respectively, and the young adults emerge in May or early June. Only one larva develops in each plant, and pupation occurs in the soil.

ARION (G.). **Entomologia agricolă.**—9½ × 6¾ in., 777 pp., 8 col. pls., 346 figs., 7½ pp. refs. Bucharest, Minist. Agric. Silvic., 1958.

This handbook of agricultural entomology for students in Rumania consists of a brief introduction on the history of entomology, two sections on the morphology, physiology and ecology of insects, one on the prevention and control of infestation, nine on insects or other pests that attack field crops, vegetables, fruit trees or bushes, ornamentals and other plants of importance in Rumania, with information on their distribution, appearance, bionomics and control, a similar one on the pests of stored products, and one on species of quarantine interest, most of which do not as yet occur in the country.

Viel (G.) & Chancogne [M.]. **Essais d'insecticides sur** *Ceratitis capitata* **dans un verger de pêchers.**—*Phytiat.-Phytopharm.* 7 no. 2 pp. 67–72, 1 graph. Paris, 1958.

In an experiment on the effectiveness of insecticides against *Ceratitis capitata* (Wied.), peach trees in an orchard near Avignon were treated with emulsion sprays containing 1 or 2 lb. DDT, 0·2 or 0·3 lb. parathion, 0·5 or 1 lb. trichlorphon (Dipterex) or 0·75 or 1·25 lb. malathion per 100 gal. on 5th June, 15 days before harvest, and three pairs of adults were caged for 48 hours with one fruit and a few leaves at the end of a branch on each tree, seven or two days before or after treatment or immediately after it. Mortality counts made at intervals on the flies caged after treatment showed that the higher dose of DDT was too low to be effective; the toxicant appeared to be slow and weak in action, but to have a slightly longer residual effect than the others. These were highly effective immediately after application, even at the lower dosages; parathion lost effect rapidly, but trichlorphon and malathion were moderately effective at the higher dosage after two days, though not after seven. The caged fruits were picked on 13th–17th June, and examination for living larvae showed that the treatments had little or no significant effect in reducing the percentage of fruits infested or the survival of larvae in the fruits under conditions of such heavy infestation.

Smith (F. G.). **Beekeeping in the tropics.**—$8\frac{3}{4} \times 5\frac{1}{2}$ in., xvii + 265 pp., 36 pls. (4 col.), 41 figs., 6 pp. refs. London, Longmans, Green & Co. Ltd., 1960. Price £2 5*s*.

This handbook for bee-keepers in tropical countries contains a chapter (pp. 45–61) on diseases and enemies of bees. Among the former, Acarine disease is caused by *Acarapis woodi* (Rennie), which breeds in the tracheae of the bees, migrating from one to another in the hive. The enemies of bees include various wasps and ants, which attack them, and several beetles and moths that are pests in hives, notably *Galleria mellonella* (L.) and *Achroia grisella* (F.), which breed in comb. Information is given on the habits and control of all these and other pests, and there is a final note on the dangers to bees of modern toxicants applied to crops for pest control. Selected references to the literature are appended.

Papers noticed by Title only.

Maksimović (M.). **Eksperimentalna istraživanja o dejstvu temperature na individualno razviće i populacionu dinamiku gubara** (*Liparis dispar* **L.**). [Experimental research on the influence of temperature on the development and population dynamics of the gipsy moth, *Lymantria dispar*.]—*Posebna Izd. biol. Inst. N.R. Srbije* pt. 3, [44 +] 115 pp., 23 graphs, 43 refs. Belgrade, 1958. (With summaries in English & Russian.)

Gunther (F. A.), Blinn (R. C.) & Barkley (J. H.). **Infrared procedure for quantitative determination of residues of 2,4,4′,5-tetrachlorodiphenyl sulfone (Tedion) on and in** *Citrus* **fruit peel.**—*J. agric. Fd Chem.* 7 no. 2 pp. 104–105, 1 graph, 8 refs. Easton, Pa., 1959.

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